

Audit



Report

OFFICE OF THE INSPECTOR GENERAL

**ACQUISITION OF AIRCREW CHEMICAL AND
BIOLOGICAL PROTECTIVE SYSTEMS**

Report No. 93-076

March 26, 1993

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Department of Defense

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Acronyms

AERP	Aircrew Eye Respiratory Protection
AFB	Air Force Base
AFMC	Air Force Materiel Command
AQD	Armor Quick Disconnect
AR-5	British AR-5 Aircrew Respiratory System
DT&E	Development Test and Evaluation
ECP	Engineering Change Proposal
EPDM	Ethylene Propylene Diene Monomer
FAR	Federal Acquisition Regulation
J&A	Justification and Approval
NADC	Naval Air Development Center
OCNO	Office of the Chief of Naval Operations
PADD	Passive Anti-Drown Device
PAT	Process Action Team
PIHM	Protective Integrated Hood Mask
TAERS	Tactical Aircrew Eye/Respiratory System
TDP	Technical Data Package
USACRDEC	U.S. Army Chemical Research, Development and Engineering Center
USAF	U.S. Air Force



INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
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March 26, 1993

MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (FINANCIAL
MANAGEMENT)
ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT AND COMPTROLLER)
INSPECTOR GENERAL, DEPARTMENT OF THE ARMY

SUBJECT: Audit Report on the Acquisition of Aircrew Chemical and Biological
Protective Systems (Report No. 93-076)

We are providing this final report for your information and use. Comments on the draft of this report were considered in preparing the final report.

The report addresses matters concerning the Air Force's acquisition objective for aircrew chemical and biological protective systems, the Navy's strategy for acquiring the systems, and the Air Force's and Navy's testing of the systems. We performed the audit in response to an inquiry from Senator William V. Roth, Jr.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, the Navy Program Manager for Aircrew Systems, the Air Force Director of Electronic Combat and Combat Support Requirements, the Air Force Program Director for Human Systems Programs, and the Army Project Manager for Nuclear Biological Chemical Defense Systems must provide final comments on the unresolved recommendations and monetary benefits by May 25, 1993. Also, Army and Air Force officials should provide us status reports on actions being taken. See the "Status of Recommendations" section at the end of each finding for the unresolved recommendations and the specific requirements for your comments. Our requests for the Army and Air Force to provide us updates on actions being taken are addressed in our audit responses to Recommendations C.1. and C.2.

As required by DoD Directive 7650.3, the comments must indicate concurrence or nonconcurrence in the finding and each recommendation addressed to you. If you concur, describe the corrective actions taken or planned, the completion dates for actions already taken, and the estimated dates for completion of planned actions. If you nonconcur, you must state your specific reasons for each nonconcurrence. If appropriate, you may provide alternative methods for accomplishing desired improvements.

If you nonconcur with the estimated monetary benefits or any part thereof, you must state the amount you nonconcur with and the basis for your nonconcurrency. Recommendations and potential monetary benefits are subject to resolution in accordance with DoD Directive 7650.3 in the event of nonconcurrency or failure to comment. We also ask that your comments indicate concurrence or nonconcurrency with the internal control weaknesses highlighted in Part I.

We appreciate the courtesies extended to our audit staff. If you have any questions on this audit, please contact Mr. Rayburn H. Stricklin, Program Director, at (703) 614-3965 (DSN 224-3965) or Mr. William D. Van Hoose, Project Manager, at (703) 693-0382 (DSN 223-0382). Appendix F lists the distribution of this report.

A handwritten signature in black ink, reading "Robert J. Lieberman". The signature is written in a cursive, flowing style.

Robert J. Lieberman
Assistant Inspector General
for Auditing

Enclosure

cc:

Secretary of the Army

Secretary of the Navy

Secretary of the Air Force

Office of the Inspector General, DoD

Report No. 93-076
Project No. 2AL-5006

March 26, 1993

**ACQUISITION OF AIRCREW CHEMICAL AND BIOLOGICAL
PROTECTIVE SYSTEMS**

EXECUTIVE SUMMARY

Introduction. This audit was conducted in response to an inquiry from Senator William V. Roth, Jr., regarding the Navy's planned urgent sole source procurement of the British AR-5 Aircrew Respiratory System (AR-5), a chemical and biological protective system for aircrews. Senator Roth was primarily concerned with the Navy's urgent need to procure 1,200 systems, at several times the price of the Air Force's system, when the urgent requirement had not been officially established.

Objective. The audit objective was to evaluate the effectiveness and efficiency of the Navy's planned procurement of aircrew chemical and biological protective systems. To accomplish this objective, we also reviewed certain aspects of Army and Air Force chemical and biological protective systems. The audit also included a review of the adequacy and sufficiency of internal controls related to the audit objective.

Audit Results. Our audit found four conditions warranting management's attention.

- o The Air Force's acquisition objective for Protective Integrated Hood Masks (PIHMs), an aircrew chemical and biological protective system, included requirements for excessive systems and system components. As a result, the Air Force may spend as much as \$20.3 million unnecessarily (Finding A).

- o The efficiency and effectiveness of the Navy's planned acquisition strategy for procuring aircrew chemical and biological protective systems were questionable. The strategy could cost as much as \$30 million unnecessarily and could result in untimely deliveries or delivery of ineffective protective systems or both (Finding B).

- o The Air Force did not adequately test the PIHM to determine if it satisfied certain performance requirements. As a result, the PIHM did not meet all performance requirements. In addition, costly modifications may be required. Also, an Army chemical and biological system utilizes the same material for its air hose as does the Air Force, which may not meet performance requirements (Finding C).

- o The Navy's conclusions regarding the performance of the PIHM as compared to the AR-5 may not be valid. As a result, the Navy may have lost benefits available on the PIHM, which may be equally effective and less costly (Finding D).

Internal Controls. We identified internal control weaknesses in the process used by the Air Force to establish its acquisition objective, by the Navy to develop its acquisition strategy, and by the Air Force and the Navy to test chemical and biological protective systems. Our review of internal controls is discussed in Part I.

Potential Benefits of Audit. The principal benefits that will be realized from implementing the audit recommendations are to reduce the Air Force's acquisition objective for PIHMs by 3,876, amounting to \$8.5 million, and PIHM blowers and

communication sets from 37,189 to 27,000, potentially resulting in \$11.8 million in cost savings; to reduce risks within the Navy by using a more cost-effective acquisition strategy with potential savings of \$30 million; and to improve Navy and Air Force test procedures, resulting in increased assurance that effective systems are procured. These potential benefits are detailed in Appendix C.

Summary of Recommendations. We recommend that the Air Force recalculate its acquisition objectives for PIHMs and PIHM blowers and communication sets; that the Navy decide that procurement of aircrew chemical and biological protective systems is not urgent and reduce cost risks through the use of full and open competition procedures; that the Air Force continue the implementation of its corrective action plan to further test and determine the operational effectiveness of its protective system; that the Army re-evaluate the use of Ethylene Propylene Diene Monomer material for its chemical and biological protective systems; and that the Navy equitably compare the PIHM, AR-5, and other potential systems before initiating any procurement and provide an adequate operational test and evaluation of any system before procurement.

Management Comments. Management's comments to our recommendations were very responsive. Management acted on all the recommendations. Those actions generated savings, set the basis for future savings, and should assure the effectiveness of the aircrew chemical and biological protective systems. However, we believe that, in implementing our recommendation on recalculating the acquisition objectives, the Air Force should limit its procurement of blowers and communication sets to one per aircraft crew seat rather than one per aircrew member. Our basis is that the Services had more aircrew members than aircraft seats and that the blowers and communication sets are detachable. The Air Force concerns about the difficulty in controlling blowers and communications sets in toxic environments are understandable, but we remained convinced that the Air Force should limit its procurement. The equipment is not necessary and about \$11.8 million could be saved by not buying it. We have asked the Air Force to reconsider its position and to comment again on the recommendation in response to this report. These comments should be provided by May 25, 1993.

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This report was prepared by the Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, DoD. Copies of the report can be obtained from the Information Officer, Audit Planning and Technical Support Directorate, (703) 614-6303 (DSN 224-6303).

Part I - Introduction

Background

Aircrew chemical and biological protective systems protect aircrews from chemical and biological agents so that the aircrews can accomplish their missions when working in a contaminated environment. Aircrew protection systems generally consist of a hood mask, blower, and communications set. In addition, the aircrew wear below-the-neck chemical and biological protective clothing.

In 1985, the Air Force decided to replace its aircrew protective system. The Air Force tasked Quest Research Corporation (Quest) to identify and evaluate off-the-shelf aircrew chemical and biological protective systems. Quest identified and evaluated 14 systems and recommended 5 systems for consideration. The five systems recommended for evaluation included the British AR-5 Aircrew Respiratory System (AR-5) and the Protective Integrated Hood Mask (PIHM) (Figure 1).

In 1986, the Navy and the Air Force began a joint program for procuring a chemical and biological protective system for their aircrews. In June 1987, the Air Force, as the lead Service for the joint program, awarded a contract to the Boeing Military Airplane Company (Boeing) for development of the PIHM for use with Air Force aircraft and life-support equipment. The contract included options for the Navy. During 1986 and 1987, concurrent with the Navy's participation in the joint program to procure PIHMs, the Marine Corps procured 3,190 AR-5s from the British manufacturer using sole source contracts. Also during this period, the Navy considered the AR-5 for its aircrews and negotiated with a British firm for the purchase of the AR-5 Technical Data Package (TDP). A price of approximately \$6 million was negotiated. The Aircrew Systems Program Office requested that the Aviation Supply Office procure the TDP. However, the procurement was denied by the Aviation Supply Office because funds were not available.

In September 1987, at the joint program's first program management review, the Navy made known its dissatisfaction with the joint program. The Navy continued, until it terminated its participation in the joint program, to indicate dissatisfaction with the performance of the PIHM and with Boeing's efforts to integrate the PIHM with Navy aircraft and life-support equipment. In May 1988, the Air Force indicated a desire for the Navy to terminate its participation in the joint program. The Navy terminated its participation in June 1991 and continued efforts to procure the AR-5.

In October 1990, the Air Force entered the production phase for the PIHM. As of September 30, 1992, the Air Force had purchased 15,800 PIHMs out of an acquisition objective of 41,056. The Navy still did not have a chemical and biological protective system for its aircrews.

CHEMICAL AND BIOLOGICAL PROTECTIVE SYSTEMS

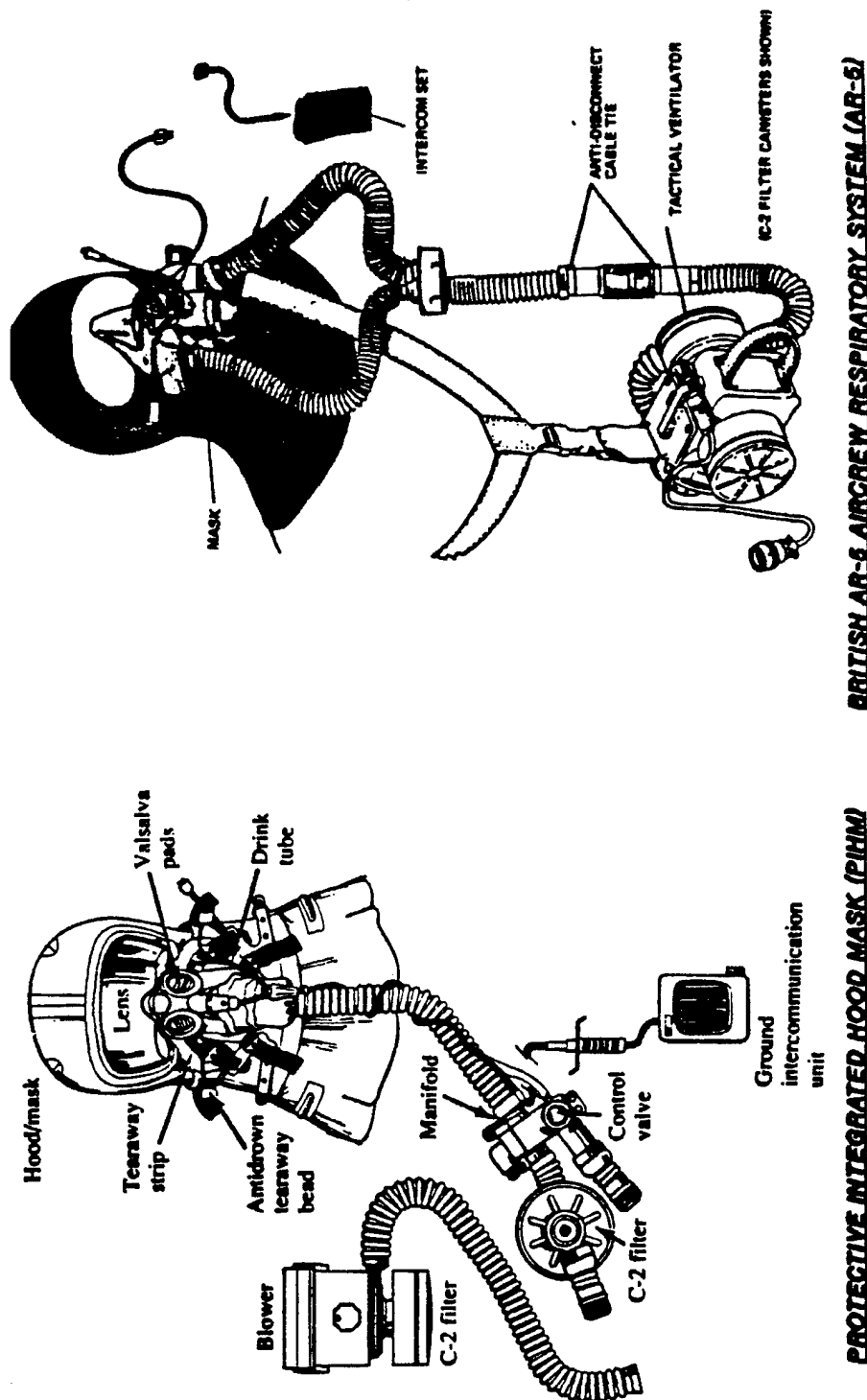


Figure 1

Introduction

In May 1992, the Office of the Inspector General, DoD, received an inquiry from Senator William V. Roth, Jr., regarding the Navy's planned urgent procurement of the AR-5. Specifically, Senator Roth was concerned with the urgency to buy 1,200 AR-5s, at several times the cost of the Air Force's PIHM, without establishing the urgent requirement.

Objectives

The audit objective was to evaluate the effectiveness and efficiency of the Navy's planned procurement of aircrew chemical and biological protective systems. Specifically, the audit included reviews of the mission need statement, procurement justification, funding, and alternative systems. Our review of alternative systems resulted in reviews of aspects of Army and Air Force chemical and biological protective systems. In addition, we reviewed the Air Force's quantitative requirements for aircrew chemical and biological protective systems. Our review of the mission need statement, procurement justification, alternative systems, and the Air Force's quantitative requirements resulted in the four findings presented in Part II. The results of our review of funding are discussed in the "Other Matters of Interest" section.

Scope

This performance audit was conducted from May through September 1992. The audit was performed in accordance with the auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD, and included necessary tests of internal controls. We reviewed data and information that was dated from October 1986 through September 1992. We interviewed personnel involved in the acquisition and testing of aircrew chemical and biological protective systems and other responsible personnel. Our review did not cover work being done to ensure that chemical and biological protective systems provided protection against biological agents. However, this matter is discussed in the "Other Matters of Interest" section. Appendix E lists the activities visited or contacted during the audit.

Internal Controls

We reviewed internal controls applicable to the acquisition and testing of aircrew chemical and biological protective systems. In assessing the internal controls, we evaluated internal control techniques, such as management plans, written policies and procedures, and management-initiated reviews. The audit

identified material internal control weaknesses as defined by Public Law 97-255, Office of Management and Budget Circular A-123, and DoD Directive 5010.38.

- o Controls were not established to ensure that the Air Force would procure only the quantity of chemical and biological protective equipment needed. Implementation of Recommendation A.1. and A.2. will correct this weakness. If implemented, the Air Force will save approximately \$20.3 million in unnecessary procurement costs.

- o Controls were ineffective to ensure that the Navy selected the most cost-effective acquisition strategy. Recommendations B.1., B.2.a., and B.2.b. will correct the weakness. Implementation of these recommendations will allow the Navy to procure the most cost-effective system to meet its needs and may result in approximately \$30 million in funds being put to better use.

- o Controls were not established to ensure that the Air Force's developmental and operational testing included tests of all performance requirements and that test results were evaluated adequately. Recommendation C.1. addresses these weaknesses. If implemented, the Air Force will field a system that meets most performance requirements.

- o Controls did not ensure that the Navy's comparison of aircrew chemical and biological protective systems was valid. If implemented, Recommendations D.1., D.2., D.3., and D.4. will correct this weakness. Implementation will ensure that the Navy fields the most operationally effective and suitable system.

A copy of this final report will be provided to the senior officials responsible for internal controls in the Departments of the Navy and Air Force.

Prior Audits and Other Reviews

The Inspector General, DoD; Service Audit Agencies; and the General Accounting Office have not specifically reviewed aircrew chemical and biological protective systems in the last 5 years.

Other Matters of Interest

Use of Operations and Maintenance Funds. As part of Senator Roth's inquiry, he stated that the Navy wanted to procure the AR-5 because Operations and Maintenance Funds could be used; however, if the Navy chose the Air Force mask, the Navy would have to spend procurement funds. Such funds were not available because of higher priorities. We determined that both the AR-5 and the PIHM could be purchased with Operations and Maintenance Funds because both systems would be carried onto the aircraft by the aircrews.

Introduction

The determining criteria to use Operation and Maintenance Funds were that the aircrew must wear or carry the equipment to the aircraft, while aircraft modifications required use of procurement funds. The PIHM, as configured by the Air Force, required an aircraft modification to accommodate the blower, which was mounted on the aircraft, thus confusing the issue in determining which funding would be used. The AR-5 blower was attached to the aircrew member; an aircraft modification was not required. We were informed by Navy and Air Force officials that an individually mounted blower could be used with the PIHM, thereby eliminating the use of procurement funds for aircraft modification.

Army Chemical Process Action Team. On September 26, 1990, the U.S. Army Materiel Command established the Army Chemical Process Action Team (the Team). This Team was to improve test and evaluation procedures by ensuring the validity of evaluations in support of chemical survivability throughout the acquisition cycle. The Team's efforts covered:

- o Scenarios
- o Threats
- o Liquid/vapor/aerosol challenge levels
- o Test procedures/instrumentation
- o Evaluation criteria/methodologies
- o Acceptable risks
- o Analytical methodologies/models
- o Simulant/agent correlation
- o Overall lack of standard

At the end of our audit, we asked for the completion date for the standardization of chemical and biological test procedures; the Team stated it does not have an estimated completion date.

Protection Against Biological Agents. Discussions with Navy and U.S. Army Chemical Research, Development and Engineering Center (USACRDEC) personnel disclosed that biological agents are also a real threat to U.S. Forces. They stated that biological agents enter through the respiratory system rather than through the skin. They felt that the filters on the chemical and biological protective systems met the protection requirements. An individual at USACRDEC stated that no live pathogenic tests were being performed at this time; however, simulation testing is routine. They also stated that more work was necessary in the biological detection area. The technology was not mature enough, even though the Army was now researching the advanced development of biological alarms and detectors. We were also informed that the Team will establish standards to test for biological agents once the standards for chemical testing are complete.

Part II - Findings and Recommendations

Finding A. Air Force's Acquisition Objective

The Air Force's acquisition objective for 41,056 PIHMs included requirements for excessive PIHMs and PIHM components. This condition existed because the Air Force planned to provide each qualified aircrew member with a blower and a communication set, instead of providing for a blower and a communication set for each crew space on aircraft. Also, the Air Force's requirement calculation did not consider planned reductions in force and the calculation included PIHMs for personnel in staff positions who would not be flying in a contaminated environment. As a result, the Air Force may spend as much as \$20.3 million for unnecessary PIHMs and PIHM blowers and communication sets.

Background

The Air Force developed its requirement for 41,056 PIHMs based on input from its major commands. The input provided for a PIHM for each member of the Air Force on flying status, including personnel in staff positions.

The Air Force estimated the 41,056 PIHMs will cost \$90.7 million.

<u>Component</u>	<u>Cost</u>	
	<u>Unit</u>	<u>Total</u>
Hood Mask	\$1,050	\$43,108,800
Blower	960	39,413,760
Communication Set	199	8,170,144
TOTAL	<u>\$2,209</u>	<u>\$90,692,704</u>

Audit Evaluation of Acquisition Objective

The Air Force's requirement for blowers and communication sets was overstated because the Air Force based requirements for the blowers and communication sets on the number of members on flying status. Unlike the hood mask, which each aircrew member must have since the mask must be individually sized to fit each individual, no need exists for each aircrew member to have a blower and communication set. The aircrews need the blowers only when preparing for and performing missions. As such, we concluded that the

Finding A. Air Force's Acquisition Objective

Air Force's requirements for blowers and communication sets should be based on aircrew seats in each aircraft rather than on each aircrew member on flying status.

The responsibility for management of quantitative requirements for PIHMs was transferred from Headquarters, Air Force, to the Air Combat Command from October 1989 through January 1990. Air Combat Command officials told us that procedures for evaluating requirements received from field activities had not been established.

Effect of Overstated Air Force Requirements

By assigning a blower and communication set to each crew space on aircraft plus obtaining 10 percent for spares, the requirements for blowers and communication sets would decrease from 37,189 to 27,000, a reduction of 10,189. The 37,189 was calculated by reducing the Air Force's requirement for 41,056 PIHMs by 3,867, the number of PIHMs inappropriately included in the Air Force's requirements as a result of the Air Force not considering planned force reductions and personnel in staff positions that will not be flying in a contaminated environment. By multiplying the 10,189 blowers and communication sets by the current acquisition cost of \$960 for the blower and \$199 for the communication set, we estimated that approximately \$11.8 million could be saved by buying the two components only for each aircrew space on aircraft plus spares (Appendix A).

Furthermore, in discussing the effects of the overstated requirements with Air Force officials, they stated that the total acquisition objective of 41,056 was excessive for two additional reasons. First, the 41,056 included PIHMs for personnel in staff positions who would not be flying in a contaminated environment. Second, the requirements data provided by field activities were based on aircraft inventory when the data were provided and did not consider planned reductions. Management stated that the acquisition objectives would be recalculated giving consideration to our conclusion and the two additional factors.

Conclusion

The Air Force overstated its acquisition objectives for PIHMs and PIHM components. The acquisition objectives for blowers and communication sets could be overstated by as much as \$11.8 million. This overstatement of \$11.8 million could be reduced based on the Air Force identifying those activities and missions where a greater ratio than one blower and one communication set per aircrew seat is required. The Air Force identified in its response to the draft report an additional overstatement of \$8.5 million

Finding A. Air Force's Acquisition Objective

(3,867 PIHMs, including hood masks, blowers and communication sets) in the acquisition objective. That overstatement resulted from the Air Force not considering planned reductions in force or the needs of personnel in staff positions who would not be flying in a contaminated environment to have PIHMs. This finding was revised to reflect the Air Force's calculated reduction of 3,867 PIHMs. Therefore, the Air Force's acquisition objective for PIHMs and PIHM components could be overstated by as much as \$20.3 million.

Recommendations, Management Comments, and Audit Responses

We recommend that the Air Force, Director of Electronic Combat and Combat Support Requirements:

1. Revise the acquisition objectives for hood masks, blowers, and communication sets, which are components of the Protective Integrated Hood Mask. This revision must consider any planned reductions in aircraft inventory, personnel assigned to staff positions who will not be flying in a contaminated environment, and that blowers and communications sets are required at a ratio of one per aircrew seat, plus spares, except for specifically designated aircraft and missions.

Air Force Comments. The Deputy Director, Fighter, C2 and Weapon Programs, Office of the Assistant Secretary of the Air Force (Acquisition), partially concurred with the recommendation. The Deputy Director stated that the Air Force recalculated its acquisition objective for PIHMs, taking into consideration planned force reductions and personnel in staff positions who would not fly in a contaminated environment, which resulted in the reduction of the Air Force's acquisition objective from 41,056 to 37,189 PIHMs or 3,867 PIHMs for a savings of \$8.5 million. However, the Deputy Director nonconcurred with the portion of the finding and recommendation that stated that blowers and communications sets are only required at a ratio of one per aircrew seat. The Deputy Director stated that the varied aircrew taskings and the difficulty of controlling equipment in a toxic environment make it likely that combat sorties would be delayed or cancelled by the nonavailability of needed equipment if issued on a one per seat basis. The complete text of the Deputy Director's comments is in Part IV.

Audit Response. The Deputy Director's efforts in reducing the acquisition objective for the PIHMs were commendable. However, his comments to the portion of Recommendation A.1. regarding blowers and communication sets were not responsive. His comments did not specify how and to what extent our recommended action would adversely affect the Air Force's ability to accomplish its combat sorties. Also, the Deputy Director's comments did not explain why the Air Force needed 10,189 blowers and 10,189 communication sets over and above the additional 3,000 blowers and 3,000 communication sets that we included as spares in our requirements calculation which is shown in Appendix A.

Finding A. Air Force's Acquisition Objective

The 13,189 sets of equipment represent an increase of about 55 percent (13,189 divided by 24,000) in requirements for the blowers and communication sets. Furthermore, there will be more sets of equipment available at all times because all aircraft will not always be operationally ready due to maintenance and supply conditions. With a high aircraft operationally ready rate of 90 percent, there would be an additional 2,400 sets of equipment available for aircrews to use. As such, the Air Force's acquisition objective could have as many as 15,589 blowers and 15,589 communications sets (72 percent) over the 21,600 sets of equipment needed for operationally ready aircraft.

After considering the Deputy Director's comments on the action that we recommended for the blowers and communication sets, we continue to question the need for the Air Force to acquire substantially more blowers and communication sets than are required for seats in its operational aircraft. We also question how our recommended basis for determining requirements would adversely affect the Air Force's ability to accomplish combat sorties if there are sufficient quantities of spare blowers and communication sets available for those sorties. As such, we ask the Air Force to reconsider its position on the portion of Recommendation A.1. regarding blowers and communication sets and to comment again on the recommendation in response to this report.

2. Establish written procedures for review and validation of requirements received from field activities.

Air Force Response. The Deputy Director concurred with the recommendation. He stated that the Air Force established written procedures on February 1, 1993, requiring the Chemical/Biological Program Manager to conduct requirement reviews quarterly or upon changes of force structure. The full text of the Deputy Director's comments is in Part IV.

Audit Response. We consider the Deputy Director's actions and comments to be responsive. Therefore, no further comments are needed on Recommendation A.2.

Status of Recommendations

		Response Should Cover:				
<u>Number</u>	<u>Addressee</u>	<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
A.1.	Director, Elec- tronic Combat and Combat Support Requirements	x	x	x	x	x

Finding B. Navy's Planned Acquisition Strategy

The Navy's planned two-phased acquisition strategy for procurement of aircrew chemical and biological protective systems was questionable. The first phase was questionable because the Navy had not validated the urgency of the planned sole source procurement of 1,200 AR-5 hood masks. The second phase was questionable because an option was included for the Navy to use the TDP for the AR-5 for its planned competitive procurement of 6,510 chemical and biological protective systems. As a result, the Navy could spend as much as \$30 million unnecessarily for chemical and biological protective systems and could receive untimely deliveries or deliveries of unsatisfactory protective systems or both.

Background

In early 1992, the Navy and the Marine Corps established acquisition objectives of 6,000 and 4,900, respectively, for aircrew chemical and biological protective systems. From 1986 to 1987, the Marine Corps had procured 3,190 AR-5s under sole source procurement procedures. The Navy selected a two-phased acquisition strategy for procuring the remaining requirement of 7,710 chemical and biological protection systems. The first phase was an urgent sole source procurement of 1,200 AR-5 hood masks. However, the first phase was contingent upon the Navy's validation of the urgency of the requirement and the AR-5's successfully passing a technical evaluation. Neither milestone had occurred as of the date of this report. The second phase was a competitive procurement of 6,510 chemical and biological protection systems through a Non-Development Item best value approach or full and open competition using the AR-5 TDP. The Navy planned to perform a cost-benefit analysis before determining the second phase approach.

Urgent Sole Source Procurement

The Navy had justified neither the urgency nor the necessity for the sole source procurement. The urgency had not been supported by a written justification or an intelligence assessment. At the end of our audit fieldwork, the Office of the Chief of Naval Operations (OCNO) was in the process of determining if the urgency was justified. Also, the planned sole source procurement did not appear to meet the criteria of Federal Acquisition Regulation (FAR) 6.3, "Other than Full and Open Competition." However, the Navy was waiting for the urgency to be validated before the preparation of a Justification and Approval (J&A) for other than full and open competition.

Finding B. Navy's Planned Acquisition Strategy

Justification of Urgency. The Navy had not justified the urgency of the planned procurement. In April 1992, the Survivability Enhancement Requirements Officer requested that the Atlantic Fleet, Pacific Fleet, and Marine Corps provide input to justify the urgency. The request was verbal; therefore, we do not know the exact wording of the request. However, we believe that the Atlantic and Pacific Fleets were requested to justify 300 each and the Marine Corps was to justify 600, for a total of 1,200 systems. The OCNO provided us with the responses discussed below.

Atlantic Fleet. The Atlantic Fleet did not support an urgent need. On May 12, 1992, the Director for Tactical Development and Training responded for the Atlantic Fleet stating that he "strongly recommended" that 300 AR-5s be purchased to meet part of the Atlantic Fleet's requirements.

Pacific Fleet. The Pacific Fleet did not support an urgent need. On August 24, 1992, the Assistant Chief of Staff for Operations responded for the Pacific Fleet stating that he recommended that 300 AR-5s be purchased to meet part of the Pacific Fleet's operational requirement. Also, discussions with Navy officials disclosed that the Pacific Fleet's reason for not providing support for the urgency was that they were not willing to use their Stock Fund money to purchase the chemical and biological protective systems.

Marine Corps. The Marine Corps has not supported an urgent need. On August 24, 1992, the Marine Corps Deputy Chief of Staff for Aviation responded that:

The Aviation Department does not concur with an urgent procurement of 600 AR-5's purchased with Fleet Marine Force Operations and Maintenance funds . . . AR-5's should be procured through Program Objective Memorandum funded lines such as Aircraft Procurement, Navy or Other Procurement, Navy.

Intelligence Assessment. Naval intelligence personnel could not validate an immediate threat. Naval Technical Intelligence Center Threat Assessment for Naval Chemical and Biological Warfare, dated March 1991, defines threat as "The sum of the potential strength, capabilities, and intentions of any enemy which can limit or negate mission accomplishment or reduce force, system or equipment effectiveness." The threat assessment noted that several countries in which the United States has a strategic interest possess a threat of chemical and biological warfare. Although this has been evident for several years, Naval intelligence personnel could not validate an immediate threat because the intent of the enemy to use chemical and biological agents was indeterminable.

Other Than Full and Open Competition. The planned sole source procurement did not appear to meet the criteria of FAR 6.3. The Navy had not prepared a written J&A as required by FAR 6.303 and 6.304 to justify "Other than Full and Open Competition." The Navy was waiting for the OCNO to decide on the urgency of the procurement. However, we were informed that the J&A would be based on FAR 6.302-1, which states "Only one responsible source and no other supplier or services will satisfy agency requirements," or

Finding B. Navy's Planned Acquisition Strategy

FAR 6.302-2, "Unusual and Compelling Urgency," or both. The Navy's inability to support an urgency was discussed previously. Also, another potentially responsible source is discussed in Finding D.

Follow-on Competitive Procurement

The Navy's planned competitive procurement of 6,510 chemical and biological protective systems may not result in full and open competition or may result in unnecessary risk to the Navy. Also, the procurement of 6,510 systems may not justify an expenditure of approximately \$6 million for the AR-5 TDP.

Competition. The Navy's planned use of the AR-5 TDP to procure its protective system may limit participation to the British firm that manufactures the AR-5. The use of the AR-5 TDP for the solicitation of proposals to manufacture chemical and biological protective systems for Navy aircrews means that any firm submitting a proposal would have to manufacture chemical and biological protective systems identical to the AR-5's systems.

The Marine Corps J&A, signed in June 1985, stated that the basis for the sole source procurement was that the firm possessed necessary production (special tooling and bonding process) that no other firm could acquire, lease, or obtain from Government sources to perform this requirement. Therefore, the design of the AR-5 and its manufacturing process differ greatly from chemical and biological protective systems manufactured by U.S. firms. To compete, a U.S. firm would be required to procure the necessary tooling and to develop new manufacturing techniques, which could not be done, according to the Marine Corps' justification for its sole source procurement. This may put the U.S. firm at a cost disadvantage with the British firm that had been manufacturing the AR-5 for at least 6 years. We believe that this cost disadvantage would be difficult to overcome with a total procurement of only 6,510. This procurement quantity may not be adequate to develop a cost-effective manufacturing process. Therefore, we believe that successful participation would be limited to the British firm.

Navy Risk. The Navy would be at risk for deficiencies of the TDP. This factor would become significant if the contract was awarded to a firm other than the British firm that was manufacturing the AR-5. Discussions with Naval Air Warfare Center officials confirmed that the Navy must ensure the adequacy and accuracy of the production TDP. Once a contract is awarded, if the contractor finds that the TDP is incomplete or inaccurate, the Navy must pay the cost of required changes. Navy officials stated that this has happened, but this is a part of doing business. Therefore, we believe that the Navy could minimize its technical risk by soliciting firms to manufacture an aircrew chemical and biological protective system using the Navy's performance specifications. Using the Navy's performance specifications would ensure full and open competition and would not preclude the Navy's procurement of the AR-5, if this was the system that was determined to best satisfy the Navy's performance specifications.

Finding B. Navy's Planned Acquisition Strategy

Cost of TDP. The procurement quantity of 6,510 systems may not justify an expenditure of approximately \$6 million for the AR-5 TDP. We do not know what the AR-5 TDP will cost the Navy. However, from 1986 to 1987, a cost of approximately \$6 million was negotiated by the Navy. Therefore, the cost of the AR-5 TDP would be approximately \$922 per AR-5. If the contract was awarded to the British firm, as discussed, this would waste approximately \$6 million.

Cost of Systems. The Navy could spend as much as \$30 million unnecessarily by procuring the AR-5 for its aircrews. The aircrew chemical and biological protective systems with modifications procured by the Air Force for its aircrews may satisfy the Navy's unique requirements. The cost of 7,710 PIHMs would be approximately \$8.1 million, while the cost of 7,710 AR-5s would be approximately \$32.4 million, for a net savings of approximately \$24.3 million. This calculation assumes that the cost of the PIHM would remain approximately the same after modifications to meet the Navy's requirements. Also, unit cost data for the AR-5 were based on a procurement quantity of 50, and unit cost data for the PIHM were based on a procurement quantity of 10,500. In addition, the Navy could spend \$6 million unnecessarily for the AR-5 TDP, as discussed. Using performance specifications for the procurement of aircrew chemical and biological protective systems would allow these potential savings and not compromise the Navy's performance requirements.

Conclusion

We believe that the most risk-free and cost-effective manner for the Navy to procure its aircrew chemical and biological protective systems would be to use the Navy's performance specifications for one competitive procurement of 7,710 aircrew chemical and biological protective systems.

Discussions With Management

Navy officials stated that before a sole source procurement of the AR-5 is initiated, the urgency of the procurement must be validated and the AR-5 must pass an ongoing technical evaluation. Neither milestone has occurred; therefore, the Navy considered our finding to be premature. Also, a decision to use the AR-5 TDP in the planned follow-on competitive procurement has not been reached; before deciding, the Navy will perform a cost-effectiveness analysis. Although the OCNO has not validated the urgency of the procurement, we believe that the urgency is not supportable. Also, in addition to making a cost-effectiveness analysis to determine if the AR-5 TDP should be used for the follow-on competitive procurement, we believe that the Navy must consider the risks, as we discussed.

Recommendations, Management Comments, and Audit Responses

1. We recommend that the Chief of Naval Operations adhere to the input from the Atlantic and Pacific Fleets and the Marine Corps and decide that procurement of aircrew chemical and biological protective systems is not urgent and does not justify the use of sole source procurement procedures.

Navy Response. The Acting Assistant Secretary of the Navy (Research, Development and Acquisition) stated that he partially concurred with the recommendation. He stated that he arrived at the same conclusion as the auditors, however, his conclusion was based on different reasons. He stated that the Commanders-in-Chiefs could not support an urgent need because of the cost of the protective systems, not because they were not urgently needed. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. Although the Acting Assistant Secretary only partially concurred, his actions to terminate the Navy's efforts to support an urgent procurement satisfied the recommendation. Therefore, no further comments are required for Recommendation B.1.

2. We recommend the Navy Program Manager, Aircrew Systems:

a. Use full and open competition procedures for any procurements of aircrew chemical and biological protective systems.

b. Perform cost-effectiveness and risk analyses to evaluate the cost and risk impact of using the British AR-5 Aircrew Respiratory System's Technical Data Package for competitive procurement as opposed to the Navy's performance specifications before deciding whether to use the British AR-5 Aircrew Respiratory System's Technical Data Package for procurement purposes.

Navy Response. The Acting Assistant Secretary of the Navy (Research, Development and Acquisition) concurred with the recommendations. He stated that the actions recommended were part of the Navy's approved acquisition strategy. However, the Acting Assistant Secretary nonconcurred with the estimated monetary benefits of \$30 million. He stated that the \$6 million for the AR-5 technical data package was not negotiated or determined to be acceptable by the Navy. Also, the \$24 million resulting from a comparison of the unit cost of the AR-5 to the unit cost of the PIHM was not valid. The comparison was not valid because the unit costs were based on significantly different procurement quantities. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. We consider the Acting Assistant Secretary's comments to be generally responsive in regards to the recommendations. However, the recommended actions were not part of the Navy's acquisition strategy at the time of our audit. The Navy's planned sole source procurement of the chemical and biological protective systems was the reason for our audit. In regards to the

Finding B. Navy's Planned Acquisition Strategy

estimated monetary benefits, the estimated \$30 million was based on the best data available. No further comments are necessary as to Recommendations B.2.a. and B.2.b. However, we request that the Acting Assistant Secretary reconsider his nonconcurrency with the monetary benefits. If the Navy has more valid estimates, then they should provide them to us.

Status of Recommendations

		<u>Response Should Cover:</u>				
<u>Number</u>	<u>Addressee</u>	<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
B.2.a.	Program Manager, Aircrew Systems				x	

Finding C. Air Force's Testing

The Air Force did not test the PIHM to determine if it satisfied certain performance requirements. This condition resulted because the Air Force did not test against some requirements and in other cases did not evaluate test results adequately. As a result, the PIHM did not meet all performance requirements and may need costly modifications, although the PIHM may have been an improvement over the system that was being replaced.

Background

The purpose of developmental and operational testing is to ensure that systems satisfy performance requirements and are operationally effective and suitable. The Air Force conducted developmental and operational testing of the PIHM on representative aircraft for each mission category. These aircraft models included the MH-53-J, AC-130H, C-130E, C-9A, F-16, KC-135, and B-52. Testing related to the B-1 was scheduled to begin August 1992.

Testing Against Requirements

The Air Force did not test the PIHM against certain requirements contained in the Air Force's Technical Requirements Document. Tests were not conducted to determine the level of chemical vapor permeation of the PIHM hose assembly or the physiological effects that could occur during the entire 16-hour wear-time requirement.

Chemical Vapor Permeation. The Air Force testing was limited and gave no assurance that toxic chemical vapors would not penetrate the hose assemblies of the PIHM to levels of contamination that could incapacitate or kill users.

Air Force Testing. The Air Force did not test the PIHM hose assembly for chemical vapor permeation. The hose was made of Ethylene Propylene Diene Monomer (EPDM) which had been used by the Army for chemical defense equipment for about 10 years. The Air Force and Boeing, the prime contractor for the PIHM, believed that testing the hose assembly was not necessary because of the Army's use of EPDM. Also, the Air Force relied on verbal assurance from an official of the USACRDEC that EPDM provided 10 to 16 hours of protection against liquid chemical agents and that liquid chemical agent challenges were considered more penetrating than vapor chemical agents.

Finding C. Air Force's Testing

Navy Testing. The Air Force did not follow up on hose permeation problems identified during Navy testing. The Navy tested the PIHM hose assembly for chemical vapor permeation when the Air Force and Navy were participating in a joint program for the procurement of an aircrew chemical and biological protective system. The Navy tasked Dayton T. Brown, Inc., who in turn tasked the Calspan Advanced Technology Center (Calspan) to test the PIHM for permeation of vapor chemical agents. The Calspan test included five PIHM hose assemblies that were tested against a mustard chemical agent. All five hose samples failed to meet permeation requirements. Permeation of the mustard agent to an unacceptable level occurred at 5 hours 17 minutes in the worst case and at 10 hours 38 minutes in the best case. The Air Force and Navy requirement was for the hose to resist permeation above a specific level for 16 hours.

The Navy requested the USACRDEC to verify the Calspan test results. USACRDEC reviewed the Calspan test procedures and results and stated that the results were based on a valid test method.

Army Testing. The Air Force did not follow up on hose permeation problems identified during Army testing of the PIHM. The USACRDEC testing of the PIHM hose assembly also indicated that the hose may not meet the Air Force's 16-hour permeation requirement. The Naval Air Development Center submitted PIHM systems to the USACRDEC for qualification testing of the material. The Army required that material be tested in accordance with Military Standard 282, which mandated the use of a liquid chemical agent. USACRDEC conducted liquid chemical permeation testing of PIHM components that included the hose assembly. The testing threshold was for the components to resist permeation for 450 minutes. USACRDEC's test report dated February 19, 1991, stated that liquid mustard agent permeated the PIHM hose material in 285 minutes (4 hours 45 minutes).

Physiological Factors. The Air Force did not test the PIHM to evaluate physiological factors related to the required 16-hour wear time, heat stress, and breathing resistance. However, the Air Force did evaluate physiological factors for periods less than the required 16 hours. These physiological factors could effect the ability of the aircrews to perform their missions while wearing the PIHM.

Sixteen-Hour Wear time. The Air Force did not conduct tests to determine fully if aircrew members could wear the PIHM and other protective clothing for the required 16 hours. The Air Force required that the PIHM be capable of being worn for the duration of all training and combat missions. Test reports did not state the time that the aircrew members wore the PIHM during testing. However, operational test reports stated that test subjects were allowed to remove their masks every 2 to 3 hours. Therefore, the Air Force did not evaluate the PIHM in a realistic operational scenario. Because of this limitation in testing, physiological problems related to the extended wear time may have not been identified.

Heat Stress. Air Force operational testing did not fully evaluate the effects of heat stress related to the wearing of the PIHM and other protective

Finding C. Air Force's Testing

clothing in spite of problems identified with heat stress during developmental testing. Developmental testing of the PIHM identified heat stress as a major concern with the use of the PIHM and classified heat stress as a "Part 1 Deficiency." A "Part I Deficiency" is defined as a condition that may cause death, severe injury, or major system damage. The developmental test reports cited critical problems related to the aircrew's performance of mission-critical functions, such as preflight duties. Other Air Force evaluations identified heat stress problems.

Our review of operational test reports disclosed that the evaluation of the level of heat stress caused by wearing the PIHM and the potential effects of heat stress on mission accomplishment were not the objectives of operational testing. As a result, most operational testing was conducted without the aircrew members wearing the protective clothing. Operational testing of the PIHM did not evaluate heat stress in relation to the length of time an aircrew member would be required to wear the PIHM to perform the mission. Aircrew members were allowed to take the PIHM mask off every 2 to 3 hours. Test reports also did not indicate how long the aircrew wore the PIHM for testing. This did not allow for the evaluation of heat stress in relation to the continuous wearing of the system.

Breathing Resistance. During operational testing, the Air Force did not adequately address those breathing resistance issues that were identified during developmental testing of the PIHM for use on aircraft models KC-135 and C-9A. Also, other Air Force evaluations indicated serious problems related to breathing resistance.

At the end of the developmental flight tests, test subjects were provided questionnaires to evaluate physiological problems experienced while wearing the PIHM. Results of these tests rated breathing resistance as a major complaint, and the Air Force recommended that breathing resistance be closely monitored during operational testing to determine whether the problem experienced during developmental tests would be magnified under operational conditions. However, the operational test report on the KC-135 did not discuss in detail the issue of breathing resistance.

In addition, Air Force altitude and acceleration evaluations of the PIHM for use in fighter aircraft confirmed a high respiratory resistance. Also, testing of the PIHM for use in fighter aircraft found the resistance to breathing to be as bad as the system that the PIHM was replacing.

Evaluation of Test Results

The rating process consisted of two methods. The first method provided for ratings of 1 to 5 with 1 being completely unacceptable, 2 somewhat acceptable, 3 borderline, 4 somewhat acceptable, and 5 completely acceptable. The second method asked the test subjects to rate the factor as worse than, the same as, or better than the current aircrew protective system. The Air Force rated the

Finding C. Air Force's Testing

PIHM as satisfactory if both methods of evaluation were rated satisfactory by 68 or more percent of the test subjects. Both methods required the test subjects to rate factors specific to the PIHM. If 68 percent of the test subjects rated the factor between 2 and 5 for the first method and 68 percent of the test subjects rated the factor as the same or better for the second method, the Air Force rated that factor as satisfactory.

The Air Force did not always compare test results to the absolute requirements. Also, in the case of chemical vapor permeation of the valsalva pads, the Air Force's acceptance of Boeing's rationalization may not be valid.

Aircrew Visibility. The Air Force's Technical Requirements Document required that the PIHM eliminate lens fogging within 10 seconds. However, developmental test reports did not address the PIHMs' ability to defog or demist the lens in the required 10 seconds or less. Therefore, the PIHM may not provide the required visibility for aircrews because of lens fogging. During developmental testing, the issue of lens fogging was in a questionnaire given to the aircrews. The test subject rated the factor "freedom from lens fogging," using a rating system of 1 to 5. No question asked the length of time required to demist a fogged lens.

Developmental test reports for aircraft model C-9A showed that pilots rated the PIHM unacceptable as to lens fogging on one-third of the missions. Only 67 percent of the pilots rated the PIHM as acceptable. However, because the 67 percent acceptability rating was near the Air Force's passing threshold of 68 percent, the PIHM was rated as satisfactory. Also, we believe that one failure out of three tests should have been failing because this could result in a 33 percent loss of aircrew and aircraft.

Lens fogging was rated as a "Part 2 Deficiency" during operational testing of the F-16 aircraft. A "Part 2 Deficiency" is a condition which prevents successful mission accomplishment or degrades a system's operational effectiveness or suitability or both.

Before operational testing, Air Force aircrews indicated concern about flying with the PIHM in one-seat aircraft because of lens fogging problems encountered during developmental testing. The Air Force identified a probable cause as kinking of the demist hose and was taking action to correct the kinking problem. However, the Air Force did not conduct follow-up testing to determine if the lens fogging problem related to the F-16 had been corrected.

From May 4 to 8, 1992, the Human Systems Development Office at Brooks Air Force Base, Texas, hosted a combined Chemical Warfare Defense and Air Base Operability Program Review. The review identified the issue of lens fogging with the PIHM as a problem that would require resolution before fielding. The Air Force has indicated that an engineering change proposal will provide for a thicker, stronger wall for the demist hose, which will prevent the hose from collapsing.

Finding C. Air Force's Testing

Valsalva Maneuver. The PIHM also did not meet the requirement for the performance of an one-handed valsalva maneuver. A valsalva maneuver is a forceful attempt to adjust middle ear pressure while holding the nostrils closed. This maneuver was difficult because the aircrew member's entire head was covered by the PIHM. In addition, the aircrew member would be wearing gloves if the entire chemical protective outfit was worn.

Developmental test reports showed that only a few aircrew persons could perform a one-handed valsalva maneuver but that most aircrew could perform a two-handed valsalva maneuver. Test reports did not disclose whether the chemical defense gloves were worn during testing, making the maneuver more difficult to perform. For example, the developmental test that evaluated the aircrew's ability to operate aircraft model AC-130H showed that 76 percent of the test subjects could not perform a one-handed valsalva maneuver. However, the Air Force rated the PIHM satisfactory because no one could perform the valsalva maneuver with the prior chemical protective system.

Valsalva Pads. The Air Force accepted Boeing's rationale that the valsalva pads would meet its chemical permeation requirements. This acceptance may be invalid for three reasons.

- o No definable level of agent concentration could be considered detrimental to humans. Factors such as agent dosage and exposure time to the agent were situation dependent and difficult to measure. Further, in all chemical vapor permeation tests, the PIHMs valsalva pad areas failed to meet agent challenge criteria.

- o Boeing did not consider the location of the valsalva pads in its rationale. The valsalva pads were located directly below the eye. Thus, chemical agent exposure to the eyes would result in miosis, causing contraction of the pupils and tunnel vision.

- o The heat stress associated with wearing the PIHM was not considered in relation to chemical exposure. The effects of chemical agents, such as mustard, are intensified when the human body temperature is elevated.

These three oversights in Boeing's rationale, combined with the unfavorable chemical permeation test results of the valsalva pads, may allow chemical agent exposure, which could result in performance degradation of aircrew missions or in the death of aircrew members. The Air Force was investigating ways to improve the valsalva capabilities of the PIHM system, such as changing the material of the valsalva pads to a continuous butyl rubber material. They intend to conduct independent testing of the valsalva region and the entire PIHM to determine chemical permeation and to verify Boeing's justification to accept permeation of the valsalva regions.

Other Test Issues

During November 1991, Air Force operational testing of the PIHM system also disclosed problems with the Armor Quick Disconnect and water drag survivability.

Armor Quick Disconnect. During Initial Operational Test and Evaluation for the F-16, the Armor Quick Disconnect attachment to the chemical and biological filter inadvertently disconnected in flight because it was too loose. These disconnects gave no warning to the aircrew member and could subject the aircrew member to hypoxia if a need for aircraft oxygen occurred. The Air Force should ensure that future design for the lower portion of the Armor Quick Disconnect preclude separation when attached to the filter.

Water Drag Tests. The Air Force waived water drag qualification testing. A request for deviation was submitted by Boeing and was approved by the Human Systems Program Office during the PIHM Initial Operational Test and Evaluation because of the difficulties encountered when the actual test subjects made several unsuccessful attempts to grab the tear-away pull tab. At that point, too much time elapsed and the subject had to completely doff the system. The Air Force decided to develop a Passive Anti-Drown Device (PADD) because of concerns over the possibility of suffocation if the aircrew member was unconscious during emergency egress. The prime contractor, ILC Dover, Inc., subcontracted out to develop a PADD. The subcontractor had problems with delivering a product that did not cause electromagnetic interference. The Air Force should ensure the subcontractor delivers a PADD that interfaces effectively with aircrew life-support systems and Air Force aircraft before first article testing.

Actions Taken by Air Force

On August 21, 1992, we informed personnel of the Air Force Human Systems Programs Office of the initial results of our review. That same day, the Air Force initiated a review of our tentative conclusions. On October 6, 1992, we met with personnel of the Human Systems Program Office to discuss the issues presented in this finding. On October 30, 1992, the Air Force provided us an action plan that addresses all issues contained in this finding (see Appendix B). Also, in response to the draft report, the Air Force provided us an updated status report, which is included in Part IV. We concluded that our concerns will be satisfied if the Air Force adheres to this action plan. We commend the Air Force for its timely response to our initial notification of tentative results.

Finding C. Air Force's Testing

Army System

The Army should redetermine the effectiveness of the EPDM material for the hose assembly of the Army's M-42 respiratory system. The Army had a 6-hour, versus the Air Force's 16-hour permeation protection requirement; USACRDEC test results showed that the M-42 hose met this Army requirement. However, due to the chemical vapor permeation problems identified during testing by the Navy, Air Force, and USACRDEC, we believe that the Army should revalidate the use of EPDM for the M-42 system.

Recommendations, Management Comments, and Audit Responses

1. We recommend that the Air Force's Program Director for Human Systems Programs continue with the implementation of its corrective action plan, "Aircrew Eye/Respiratory Protection Status and Action Plan," dated October 30, 1992, provided to the Office of Inspector General, DoD, (Appendix B).

Air Force Response. The Deputy Director, Fighter, C2 and Weapon Programs, Office of the Assistant Secretary of the Air Force (Acquisition), concurred with the recommendation. He provided a report on the implementation status of the Air Force Action Plan. The full text of the Deputy Director's comments and its status report are in Part IV.

Audit Response. We consider the Deputy Director's actions and comments to be responsive; however, we request that he provide us an updated status report on Recommendation C.1. in response to this report.

2. We recommend that the Army Project Manager, Nuclear Biological Chemical Defense Systems, re-evaluate the use of Ethylene Propylene Diene Monomer material for its chemical and biological protective systems. If Ethylene Propylene Diene Monomer does not resist chemical permeation adequately, we recommend discontinuing use of this material.

Army Response. The Army Assistant Deputy Chief of Staff for Operations and Plans (Force Development) concurred with the recommendation. He stated that the Army Chemical and Biological Defense Agency convened a team of subject matter experts from that agency to test and evaluate the data compiled regarding the use of EPDM material. The team will prepare a final report and recommendations by March 31, 1993. If EPDM does not resist chemical permeation, he will recommend discontinuing use of this material. The full text of the Assistant Deputy Chief of Staff's comments is in Part IV.

Finding C. Air Force's Testing

Audit Response. We consider the Assistant Deputy Chief of Staff's comments to be responsive to Recommendation C.2.; however, we request that the Army provide the results of its evaluation to us in response to this report.

Status of Recommendations

<u>Number</u>	<u>Addressee</u>	<u>Response Should Cover:</u>				
		<u>Concur/ Nonconcur</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Monetary Benefits</u>	<u>Internal Controls</u>
C.1.	Program Director, Human Systems Programs		x	x		
C.2.	Project Manager, Nuclear Biological Chemical Defense Systems		x	x		

Finding D. Navy's Testing

The Navy's determination that the AR-5 represented a superior chemical biological protection system in comparison to the PIHM may not be valid. This condition resulted from the Navy's using methods to evaluate the AR-5 hood mask that were different from those used to evaluate the PIHM hood mask. Also, the Navy immediately rejected the PIHM, when deficiencies were identified but modified the AR-5 as deficiencies were identified. In addition, the Navy did not plan to conduct operational test and evaluation of the AR-5. As a result, the Navy may have forgone benefits available on the PIHM, which may be an equally effective, less costly protective system.

Background

The Navy conducted a technical evaluation of the PIHM and the AR-5 systems to determine which best met the Navy's specific requirements and compatibility with Navy aircraft. The technical evaluation of the PIHM system for the P-3C aircraft resulted in two test plans for flight and ground tests. These tests were conducted when the Navy was participating with the Air Force in a joint program for the procurement of aircrew chemical and biological protective hood masks and continued after the Navy terminated its participation in that joint program. The Navy wrote one test plan for the AR-5 system with the AV-8B and F/A-18 aircraft that included the evaluation of flight operations.

Evaluation Methods

The Navy did not use the same technical test criteria to evaluate the PIHM and AR-5 respiratory systems. The Navy used different types of aircraft, preflight requirements, simulator flight familiarization, and donning and doffing requirements to evaluate the adequacy and compatibility of integrating these systems with Navy-specific aircraft. As a result, the Navy did not establish a comparable test plan that would provide an equitable comparison of the two systems.

Aircraft Types. The Navy evaluated the performance of the PIHM using the aircrews of P-3C aircraft, while evaluating the performance of the AR-5 using aircrews of AV-8B and F/A-18 aircraft. This was due in part to Desert Storm when the Navy's priority aircraft for chemical and biological protective systems had changed from the AV-8B and P-3C to the AV-8B and F/A-18. However, the P-3C is completely different from the AV-8B and F/A-18, with different on-board environments and missions. Therefore, the test results for the PIHM and AR-5 systems were not comparable.

The AV-8B and F/A-18 are both carrier-based, single-cockpit aircraft. The AV-8B is an attack aircraft designed for missions, such as close air support and attack. The F/A-18 is designed for both fighter and attack missions. Both aircraft require the anti-gravity straining maneuver, which is rated as a physically demanding task for pilots. This maneuver is required only in high-performance aircraft.

The P-3C aircraft is a land-based, low-wing aircraft designed for patrol and antisubmarine warfare that has 9 to 12 aircrew members. A critical mission of the aircrew of both aircraft that requires a high physical workrate is the preflight inspection. However, the P-3C is a large aircraft that requires a preflight duty of sonobuoy loading, a physically demanding task.

The differences in aircraft mission, the required duties of the mission, and the physical workrates of such duties will directly affect the heat stress and thermal burden of a crew member, which will affect system performance. As a result, different chemical and biological protection systems require testing on the same aircraft to provide for the comparison of the complete system (hood mask, blower, and intercom).

Physiological Recorder. The Navy's technical evaluation plan stated test subjects would wear a physiological recorder when evaluating the PIHM, but the Navy test plan did not provide for a similar recorder for the evaluation of the AR-5, in spite of prior AR-5 physiological test results in Marine Corps helicopters showing that the temperature inside the chemical and biological protective ensemble rose rapidly and appeared to be a mission-limiting factor.

Preflight Duties. The Navy's test plan did not require the AR-5 test subjects to perform preflight duties; however, the Navy required the PIHM test subjects to wear the full chemical and biological ensemble and to perform preflight duties. Prior physiological tests (1988 to 1990) of aircrews using the AR-5 with the Marine Corps helicopters disclosed heat buildup in the AR-5 and a significant increase in the aircrew's heart rates during preflight activities. The aircrew's effective time flying was decreased.

Familiarization Exercises. The Navy's technical evaluation plan did not schedule PIHM test subjects to familiarize themselves with simulation flight duties while wearing the PIHM, but the AR-5 test subjects were scheduled an allotted time for simulation flight familiarization during the technical evaluation. According to the test plan, the AR-5 aircrews were given one-week simulation flight familiarization for the AV-8B and two-week familiarization for the F/A-18.

Donning and Doffing. The Navy's test plan stated that the AR-5 test subjects were provided assistance while donning and doffing; the Navy did not consider this assistance a deficiency. However, if the PIHM test subjects required assistance, the Navy recorded this fact as a deficiency. The AR-5 hood mask had been previously tested with the Marine Corps helicopter aircrews for physiological affects while donning and doffing. Results of these tests revealed it took longer to don the hood mask without assistance and that subjects commonly made errors. Unassisted doffing resulted in errors and unnecessary

Finding D. Navy's Testing

equipment damage and threatened chemical biological protection integrity. The Navy's testing activity recommended that donning and doffing of the AR-5 be carried out with the assistance of a well-trained survival equipment specialist or fellow aircrewmen and that donning be conducted at a cool room temperature.

Correction of Deficiencies

The Navy's test plan was developed to evaluate technically the Air Force PIHM as a "fly-to-buy" system, while modifications of identified deficiencies were made to the AR-5 system before its technical evaluation.

H-Manifolds. The Navy designed and built a new H-manifold for the AR-5 to provide separate flows of filtered air for hood ventilation and filtered oxygen for breathing to correct previously noted deficiencies. This system modification was included in the AR-5 technical evaluation. The H-manifold was the latest design for the PIHM system. As a result of Desert Storm, the Navy incorporated the "H" manifold with the AR-5 system. The Navy tested the PIHM with the manifold used by the Air Force, even though the Navy was aware that the Air Force manifold was inadequate for the Navy's needs. The Navy noted during P-3C technical evaluation that procedures to switch from ambient air to emergency oxygen were too complex and prone to operator error. The Navy classified this condition as a Part I Deficiency in the PIHM test results, but no corrective action was initiated.

Spectacles. The Navy allowed the use of special spectacle frames designed by the British firm that manufactures the AR-5 specifically for compatibility with the AR-5 mask during technical evaluation of the system. However, the Navy documented as a deficiency the inability of the PIHM mask to interface with standard issue spectacles.

Navy Helmet Interface. The Navy developed a helmet fitting kit to interface the AR-5 hood mask with their standard helmets, which required a bayonet-type connection. This problem was not applicable to the PIHM.

Drinking Tube. The Navy adopted a portion of the drinking tube from the PIHM for the AR-5 hood mask and incorporated this modification before the technical evaluation was conducted. This was due in part to the PIHM technical evaluation that rated the ease of drinking for the PIHM as an enhancing characteristic. In testing on Marine Corps helicopters, the AR-5 aircrew reported the drinking facility as difficult to use and listed it as a Part III Deficiency that should be avoided in future designs. A Part III Deficiency is defined as a design deficiency that is too impractical or costly to correct.

Operational Test and Evaluation

The Navy does not plan to conduct an operational test and evaluation of the AR-5 system before the urgent sole source procurement of the AR-5 hood mask, despite the fact that the AR-5 system as changed by the Navy differs from the AR-5 system deployed in Marine Corps helicopters. Navy officials stated that operational testing for the AR-5 system is not necessary because of the similarity to the AR-5 system deployed in Marine Corps helicopters.

DoD Directive 5000.2 Part 8 (4)(d) states, "All hardware and software alterations that materially change system performance (operational effectiveness and suitability) shall be adequately tested and evaluated. This includes system upgrades as well as changes made to correct deficiencies identified during test and evaluation."

The AR-5 system deployed in Marine Corps helicopters was different from the AR-5 system planned to be procured by the Navy. As discussed, the Navy designed a new H-manifold for the AR-5 system, allowed the use of special spectacles with the AR-5 mask, developed a helmet fitting kit to interface with the Navy helmet and the AR-5 hood mask, and adopted a portion of the PIHM drinking tube to enhance the AR-5 hood mask. We believe that these changes are sufficient to require operational test and evaluation of the AR-5 system. Also, the Marine Corps' use of the AR-5 system was limited to helicopter aircrews, which are considerably different from fighter/attack aircraft.

In addition, the operational impact report from Desert Storm on the use of the AR-5 system indicates there were major concerns with the system. These problems included extended wear (thermal burden), personal discomfort, and a system that cannot be donned and doffed in flight. Operational test and evaluation is needed to evaluate these problems.

Chemical Permeation

The Navy indicated that the most critical deficiency of the PIHM system was its failure to meet the Navy's chemical permeation requirement. The Navy had conducted chemical permeation tests of the PIHM and AR-5 protection systems. The PIHM system failed to meet the Navy's requirements in the valsalva pad, hose, and hood areas. The Air Force has initiated resolution of the permeation requirements for the valsalva pad and hose areas of the PIHM system (Finding C). The Air Force is coordinating its resolution actions with the Army Chemical Process Action Team, which is developing tri-Service standards for chemical and biological testing. The Navy's Calspan chemical permeation test report indicated that the hood area of the AR-5 mask allowed chemical permeation. Twenty percent of the AR-5 hood samples showed unacceptable levels of chemical permeation. As the Air Force has accepted the chemical permeation of the PIHM hood material as acceptable, the Navy should

Finding D. Navy's Testing

participate with the Army Chemical Process Action Team and the Air Force in establishing standard test methods and levels of allowable chemical permeation.

Conclusion

The Navy did not make an equitable comparison of the PIHM and AR-5 systems. The Navy used different evaluation methods, and modifications were made to the AR-5 system to correct deficiencies known prior to testing. Also, the Navy made modifications to the AR-5 system that were significant enough to require operational test and evaluation.

Discussions With Management

Navy officials stated that there was never a requirement for the Navy to conduct comparative testing of the PIHM and AR-5 systems. The Navy also stated there had been extensive Navy efforts to integrate the PIHM system with Navy aircraft and that modifications to the PIHM system would not be feasible due to the chemical permeation and operational problems of the PIHMs hood, valsalva pads, and hose. The Navy was specifically concerned with the chemical permeation of the PIHM in the hood area.

We recognize that the Navy made attempts to modify the PIHM system for Navy use; however, a large portion of the Navy's dissatisfaction with the PIHM hood mask was based on performance using the original U.S. Air Force-procured design without the inclusion of any Navy modifications. We are aware of the permeation of the hood material of the PIHM hood but recognize that there was also permeation of the hood material of the AR-5. The Air Force has concluded that this level of permeation of the PIHM will not create a hazard for its aircrews. The Army, Navy, and Air Force should determine the standard acceptable chemical permeation levels.

Recommendations, Management Comments, and Audit Responses

We recommend that the Navy Program Manager, Aircrew Systems:

- 1. Provide for an equitable comparison of the Protective Integrated Hood Mask to the British AR-5 Aircrew Respiratory System before the initiation of any procurement of the British AR-5 Aircrew Respiratory System.**

Navy Response. The Acting Assistant Secretary of the Navy (Research, Development and Acquisition) nonconcurred with the recommendation. He stated that the Navy's current acquisition strategy is to procure new chemical and biological protective systems through a competitive, nondevelopmental item, best-value approach, which will include side-by-side testing. Identical test protocols will be used for all submitted candidate systems assuring an equitable comparison. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. Although the Acting Assistant Secretary nonconcurred with our recommendation, we consider his comments and proposed actions to be responsive to the recommendation. Therefore, no further comments are required on Recommendation D.1.

2. Provide for an equitable comparison of all aircrew chemical and biological protective systems offered to the Navy in response to a Request for Proposals.

Navy Response. The Acting Assistant Secretary concurred with the recommendation. He stated that the Navy's acquisition strategy is to procure new chemical and biological protective systems through a competitive, nondevelopmental item, best-value approach, requiring all offerers to meet identical test requirements. The Navy will prepare a Request for Proposals with test requirements that will be applicable to all offerers. Preparation of a statement of work for the Request for Proposals is in progress. The estimated completion date is September 1993. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. We consider the Acting Assistant Secretary's comments to be responsive to the recommendation. Therefore, no further comments are required on Recommendation D.2.

3. Provide for adequate operational test and evaluation of any chemical and biological protective system before any system production.

Navy Response. The Acting Assistant Secretary concurred with the recommendation. He stated that a suitable operational test and evaluation will be conducted before a production decision is made. The estimated completion date is September 1995. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. We consider the Acting Assistant Secretary's comments to be responsive to the recommendation. Therefore, no further comments are required on Recommendation D.3.

Finding D. Navy's Testing

4. Participate with the U.S. Army Chemical Process Action Team to establish standards for testing chemical and biological protective systems.

Navy Response. The Acting Assistant Secretary concurred with the recommendation. He stated that joint Service standardization is necessary to assure equitable comparisons. The full text of the Acting Assistant Secretary's comments is in Part IV.

Audit Response. We consider the Acting Assistant Secretary's comments to be responsive to the recommendation. Therefore, no further comments are required on Recommendation D.4.

Part III - Additional Information

Appendix A. Audit's Calculation of Air Force Requirements for PIHM Blowers and Communication Sets

AIRCRAFT AND AIRCREW SEATS

U.S. Air Force (USAF) Aircraft	6,912
Air National Guard Aircraft	1,803
USAF Reserve Aircraft	475
Total	<u>9,190</u>

Total Crew Seats on Above Aircraft	<u>23,987</u>
------------------------------------	---------------

ESTIMATED REQUIREMENTS

Basic Requirement (23,987 rounded to nearest thousand)	24,000
10% Spares (multiplied)	2,400
Adjustment for Estimating Difference	600
Total Requirements	<u>27,000</u>

POTENTIAL SAVINGS

	<u>REQUIREMENTS</u>		
	<u>USAF</u>	<u>AUDIT</u>	<u>DIFFERENCE</u>
Number of Systems	37,189	27,000	10,189
Unit Cost ¹	\$1,159	\$1,159	\$1,159
Total Cost	<u>\$43,102,051</u>	<u>\$31,293,000</u>	<u>\$11,809,051</u>

¹Unit cost of blower (\$960) plus unit cost of communication system (\$199).

Appendix B. Air Force Action Plan

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS HUMAN SYSTEMS CENTER (AFMC)
BROOKS AIR FORCE BASE, TEXAS

FROM: YA
2701 West Road
Brooks AFB, TX 78235-5238

30 Oct 92

SUBJ: Aircrew Eye/Respiratory Protection Status and Action Plan

TO: DoD IG (Mr Tom Gimble)

1. Reference: 24 Aug 92, HSC/YA memo, subject: Chemical Surety Testing of Aircrew Eye/Respiratory Protection (AERP)

2. In response to the DoD IG audit of the AERP and our own internal review of the development program, the Human Systems Program Office is implementing the actions described in this memo. The proposed system tests and redesigns to be executed address the issues identified by the DoD IG. Observation of the planned testing and review of results by the IG are welcome. HSC/YA will provide periodic status updates during the execution of this program.

3. Chemical Vapor Permeation of the Hose Assembly The Oxygen delivery hose of the AERP is made of an Ethylene Propylene Diene Terpolymer (EPDM) rubber. After a review of USAF records we have been unable to identify any time when this hose was tested during development. The only mention of hoses in the Qualification Test Documents refers to butyl rubber hoses. In their evaluation of the USAF AERP system, the Navy, NADC, contracted CALSPAN to conduct chemical agent testing of the various components of the AERP system to include the hose. During this testing the hose failed at times ranging from 5 to 10 hours. At the time the USAF did not accept the validity of this testing, but did not have any test results of its own. In response to the current DoD IG audit HSC/YA requested Battelle, San Antonio Operations, an engineering support contractor, to repeat the testing conducted by CALSPAN and to conduct a system test of the hose in an operational configuration. This testing was subcontracted by Battelle to GEOMET Technologies Inc. and conducted on August 28 and 29, 1992.

a. The testing conducted to emulate the Navy's testing requires cutting the hoses and compressing them flat in a traditional CREDC liquid/vapor test cell. In this configuration the hoses failed based on the flat surface area of the test cell.

b. The operational full hose testing was conducted by exposing the exterior of the entire hose to chemical agent and sampling the air within the hose. In this test the hose passed, exhibiting breakthrough values of 1/17 the failure criteria (These calculations were based on the corrugated surface area of the tube). Based on the performance of the intact hoses versus the cut and flattened hoses the USAF concludes that the stress caused by the deformation of the hose for the cell test resulted in its failures. This same stress would not occur for a 16 hour period during operational use. Consequently, the full hose test is a more representative and accurate test

Appendix B. Air Force Action Plan

than the cell test for hoses. As a result the current hose meets all chemical agent permeation requirements. The USAF is formalizing this test procedure and will submit it to the Joint Service Process Action Teams as the recommended method for all hose testing. This test procedure was proposed during the 15-16 September PAT meeting at CEDEC and received positive comments from the other services. Although not specifically identified as a problem area during the AERP audit, the Air Force intends to conduct additional testing of the system's valsalva pads, to ensure the required protection is provided.

4. Chemical Vapor Permeation of the Valsalva Pads: The valsalva pads on the AERP hood are made of a thin butyl rubber. During Boeing DT&E, SRI identified the pads as allowing excessive agent breakthrough as early as the two hour point during testing with a total breakthrough of 15 ug/cm². The spec required breakthrough is 0.16 ug/cm². However, as noted in the TAERS Qualification Test Report, T560-10006-1, Boeing decided to average the agent breakthrough over the entire mask. Since no breakthrough occurred elsewhere in the mask, and the valsalva pads comprise only one three hundredths of the total exposed area of the mask, the average breakthrough was determined to be 15 ug/cm²/300 = 0.05 ug/cm². This logic was accepted by the USAF and the system was procured. Upon reviewing the overall AERP chemical agent performance in response to the DoD IG audit we evaluated the acceptability of this approach, and determined that there may be agent concentration directly behind the valsalva pads and 2-3 cm from the wearer's eyes. The expected airflow in this region of the mask might not significantly reduce the local agent concentration. Consequently, the method of averaging the breakthrough over the entire system may be incorrect. Currently the USAF plans to conduct a full AERP system test in a chemical agent environment. The test will challenge the AERP from the demist hose/oxygen delivery hose up. The test will measure both the localized agent concentrations within the mask (mainly eye region) and the total respiratory exposure to the wearer. This test is expected to be completed by January 1993. If system problems are confirmed, we intend to proceed with a program to redesign the valsalva pads to preclude agent breakthrough. Potential fixes include improved valsalva pad material, increased thickness of the current material, or integration of some cover material. Any changes made will be addressed with the user community to ensure the valsalva maneuver can still be performed with the modified system. These changes will be integrated into the next USAF AERP procurement in FY 93 and all current systems will be upgraded.

5. Lens Fogging In discussions with the testing community, it was explained that lens fogging typically occurred when untrained personnel were using the AERP system. Many of the USAF lens fogging occurrences happened when pilots of cargo or transport aircraft were using the AERP system. These pilots typically do not use oxygen masks and are not accustomed to properly fitting the mask leading to lens fogging.

a. The AERP system has recently been flown by B-1B pilots at McConnell AFB, KS, and the same crews flew the AERP during the Mighty Force Exercise at Roswell, N.M. There were no complaints of lens fogging (3 Flights, 7 Data Points).

b. Additionally, we conducted in-house testing of the AERP system in an aircraft mock-up. The individuals used as test subjects were worst case subjects (a 5' Female, a 3' Female and a 9' Male). Some minor lens fogging was noted but did not cause any vision problems. In either case, the small

facial size would allow for the most mask leakage, which would create the greatest chance for fogging.

c. The Air Force has a current data package for an Engineering Change Proposal (ECP) for the demist hose to help eliminate lens fogging. During flight testing of the AERP on F-16 aircraft the demist hose kinked in some situations inhibiting demist airflow. The ECP provided for a thicker, stronger wall for the demist hose, which will prevent the hose from kinking. This ECP is now complete and where the changes affect performance results, the Air Force will reaccomplish testing.

d. Development test data is available showing that the system cleared lens fogging within 4.5 seconds after the fogging was created. The test data is attached.

In addition to updating all current masks with the demist hose ECP, proper training with AERP will prevent lens fogging caused by improper fit.

6. Physiological Factors: Although the Air Force did conduct testing to evaluate physiological factors (heat stress, comfort, and breathing resistance), a full 16 hour test was not conducted. We are working with the user to confirm the validity of the 16 hour requirement. If the wear time is valid, the Air Force will conduct a wear test in late November 1993. Temperatures and altitudes will be based on a mission profile determined by the user. Heat stress and breathing resistance will be evaluated during this test to verify ability to perform the required mission.

7. Valsalva Maneuver: The Air Force plans to conduct additional tests and training to ensure that subjects can perform a one-handed valsalva maneuver to meet their operational requirement while wearing chemical defense gloves. If valsalva pads are redesigned as a result of chemical permeation studies, the Air Force will ensure that the valsalva maneuver can still be performed as required.

8. Other Tests: The following actions will be accomplished for the Armor Quick Disconnect and Passive Anti-Drown Device (PADDD).

a. Armor Quick Disconnect (AQD): The Air Force has a data package for an ECP that will change the strength of the Armor Quick Disconnect so that it will not inadvertently disconnect from the filter.

b. Water Drag Tests: The Air Force is developing a Passive Anti-Drown Device (PADDD) because of the problems experienced during water drag tests. There had been problems with delivery of an acceptable device from the contractor because the device caused electro magnetic interference problems during emergency ejection. These problems have been resolved and the PADDD should be ready for incorporation into the AERP during first article test in mid March 1993.

Appendix B. Air Force Action Plan

9. Plans are in place to conduct agent testing and physiological testing as required to ensure that the AKRP systems truly meet user requirements. We will integrate changes to materials, design or functionality, as necessary following the planned testing. These changes, as well as the upgrades of the O2 delivery hose, Demist hose, the AGD, and the PADD, will be integrated concurrently, timed appropriately to match with planned procurement activities at HSC/YAD, Kelly AFB, TX. Current integration is targeted sometime between Mar-Aug 93 (based on current YAD schedules). In addition HSC/YAD was directed to stop any further issuance of AKRP systems to the field units. This direction will remain in place until the above discussed corrections are in place, all concerns have been addressed, and we can supply the user with a system that meets his need. I remain committed to delivering a quality product to the users.

Marlon H. Long III

MARLON H. LONG III, Colonel, USAF
Program Director
Human Systems Program Office

1 Appendix
Lens Fogging Data

Appendix C. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
A.1.	Economy and Efficiency. Will avoid expending resources for unnecessary equipment.	Funds put to better use. The Air Force could avoid spending \$20.3 million in Air Force FYs 1993, 1994, and 1995 procurement funds.
A.2.	Program Results. Will establish procedure for the development of requirements.	Nonmonetary
B.1.	Program Results. Will ensure that sole source procurement procedures will not be used unnecessarily.	Nonmonetary
B.2.a.	Economy and Efficiency. Will ensure that the most cost-effective acquisition strategy is used.	Funds put to better use. The Navy could avoid spending as much as \$30 million in Operations and Maintenance Funds.*
B.2.b.	Program Results. Will ensure that the most cost-effective and risk-free acquisition strategy is used.	Nonmonetary

*Navy Officials indicated that aircrew chemical and biological protective systems would be procured with FYs 1995-1996 Operations and Maintenance Funds. The Navy could not specify the category of Operations and Maintenance Funds that would be used.

Appendix C. Summary of Potential Benefits Resulting From Audit

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
C.1.	Program Results. Will ensure that the PIHM will meet operational performance requirements and not pose a threat to individuals using the system.	Nonmonetary
C.2.	Program Results. Will ensure that Army systems will adequately protect their users.	Nonmonetary
D.1.	Program Results. Will ensure that the system that is operationally suitable for Navy needs will be determined.	Nonmonetary
D.2.	Program Results. Will ensure equitable comparison of all systems being considered for procurement.	Nonmonetary
D.3.	Program Results. Will ensure adequate operational test and evaluation.	Nonmonetary
D.4.	Program Results. Will help ensure uniform standards for testing of chemical and biological protective systems.	Nonmonetary

Appendix D. Glossary

Ambient Air - The air surrounding all sides of a person or thing or the encompassing atmosphere.

Antigravity Maneuver - A forceful breathing exercise to adjust to extreme changes in air pressure as experienced by tactical aircrews.

Developmental Testing - An evaluation process that measures a particular system to specific critical technical characteristics to determine if the technical threshold has been met.

Electromagnetic Interference - Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics or electrical equipment.

Fly-to-Buy - A term used by the Government to purchase a developed system in which the contractor has the responsibility to meet specific Government requirements.

H-Manifold - A manifold designed to provide separate flows of filtered air for hood ventilation and filtered oxygen for breathing.

Hypoxia - A deficiency of oxygen reaching the tissues of the body.

Miosis - Excessive smallness or contraction of the pupil of the eye.

Mustard Gas - A chemical agent that induces blistering of skin on the human body.

Operational Testing - A continuing process of evaluation that may be applied to either operational personnel or situations to determine their validity or reliability.

Physiological Recorder - A monitoring device to measure heart rate or core temperature of test subjects.

Sonobuoy - A sonar device used to detect submerged submarines that, when activated, relays information by radio.

Valsalva Maneuver - A forceful attempt to adjust middle ear pressure while holding the nostrils closed.

Valsalva Pad - An area of thin material on the mask of a respiratory protection system, which allows aircrew members to perform a valsalva maneuver more easily.

Appendix E. Activities Visited or Contacted

Department of the Army

Chemical Research, Development and Engineering Center, Aberdeen Proving Ground,
MD

Department of the Navy

Office of the Chief of Naval Operations, Washington, DC
Naval Air Systems Command, Washington, DC
Naval Technical Intelligence Center, Washington, DC
Naval Air Warfare Development Center, Warminster, PA
Naval Air Warfare Center, Patuxent River, MD
U.S. Atlantic Fleet, Norfolk, VA
Headquarters, Marine Corps Aviation Department, Washington, DC

Department of the Air Force

Office of the Air Force Deputy Chief of Staff for Plans and Operations, Washington,
DC
Air Combat Command, Langley Air Force Base, VA
Air Mobility Command, Scott Air Force Base, IL
U.S. Air Force - Europe, Ramstein Air Base, GE
U.S. Air Force - Pacific, Hickam Air Force Base, HI
Air Force Special Operations Command - Hurlbert Field, FL
U.S. Air Force Materiel Command, Wright-Patterson Air Force Base, OH
Brooks Air Force Base, San Antonio, TX
Kelly Air Force Base, San Antonio, TX
Wright-Patterson Air Force Base, Dayton, OH
Office of the Air Force Civil Engineer, Washington, DC
Air Force Intelligence Support Agency, Washington, DC
Air Force Reserve, Warner-Robins Air Force Base, GA

Defense Agencies

Defense Logistics Agency, Alexandria, VA

Non-DoD Activities

Boeing Military Airplane Company, Seattle, WA
Calspan Advanced Technology Center, Buffalo, NY
ILC Dover, Inc., Frederica, DE
Southern Research Institute, Birmingham, AL

Appendix F. Report Distribution

Department of the Army

Secretary of the Army
Inspector General, Department of the Army
Commander, U.S. Army Chemical Research, Development and Engineering Center
Project Manager, Nuclear Biological Chemical Defense Systems
Chairman, Army Chemical Process Action Team

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Financial Management)
Comptroller of the Navy
Chief of Naval Operations
Commander, Naval Air Systems Command
Commander, Naval Air Warfare Center
Program Manager, Aircrew Systems Program Office

Department of the Air Force

Secretary of the Air Force
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Commander, Air Force Materiel Command
Commander, Air Combat Command
Commander, Human Systems Center
Director, Electronic Combat and Combat Support Requirements
Program Director, Human Systems Program Office

Non-DoD Activities

Office of Management and Budget
U.S. General Accounting Office, National Security and International Affairs Division,
Technical Information Center
Chairman and Ranking Minority Member of the Following Congressional Committees
and Subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Committee on Armed Services
House Committee on Government Operations
House Subcommittee on Legislation and National Security, Committee on
Government Operations

Audit Requestor: Senator William V. Roth, Jr.

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Part IV - Management Comments

Management Comments: Army Deputy Chief of Staff for Operations and Plans (Force Development)



REPLY TO
ATTENTION OF

DAMO-FDV

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR OPERATIONS AND PLANS
WASHINGTON DC 20310-0400



8 MAR 1993

MEMORANDUM THRU ~~DEPUTY CHIEF OF STAFF FOR OPERATIONS AND PLANS~~ *12 Mar 93*

~~DIRECTOR OF THE ARMY STAFF~~ *12 Mar 93* OF THE ARMY STAFF MAR 03 93
~~ASSISTANT SECRETARY OF THE ARMY (I, L & D)~~ *Rm 5 Mar 93*

FOR INSPECTOR GENERAL, DEPARTMENT OF DEFENSE (AUDITING)

SUBJECT: DODIG Draft Audit Report on the Acquisition of Aircrew Chemical and Biological Protective Systems, Project No 2AL-5006 --INFORMATION MEMORANDUM

- 1 Reference your memo dated 11 Dec 92 requesting review and comments on recommendations of subject report (TAB A)
- 2 The Army agrees with the recommendations presented by the U.S. Army Chemical and Biological Defense Agency (TAB B) and has convened a team of subject matter experts from that agency to test and evaluate the data compiled. The team will prepare a final report with recommendations by 31 March 1993. If Ethylene Propylene Diene Monomer does not resist chemical permeation, we recommend discontinuing use of this material.
- 3 AMC (Mr. Archy Ford), USACBDA (Mr. David Hodge), DAIG (Ms. Flanagan) concur.
- 4 POC HQDA is Maj Walker, DAMO-FDV, DSN 227-9667.

Encls

[Signature]
JAS M GARNER
Major General, GS
Assistant Deputy Chief of Staff
for Operations and Plans,
Force Development

CF:
SAIG-PA
DAMO-ZQ

4 Mar 93 - APPROVED DAS.
[Signature]
AUSTIN D. BELL
LTC, GS
ADAS

U S ARMY CHEMICAL AND BIOLOGICAL DEFENSE AGENCY

COMMAND REPLY

DODIG Draft Audit Report on the Acquisition of Aircrew Chemical and Biological Protective Systems (Project No. 2AL-5006)

FINDING C - Air Force's Testing

Finding. The Air Force did not test the Protective Integrated Hood Mask (PIHM) to determine if it satisfied certain performance requirements. This condition resulted because the Air Force did not test against some requirements and in other cases did not evaluate test results adequately. As a result, the PIHM did not meet all performance requirements and may need costly modifications, although the PIHM may have been an improvement over the system that was being replaced.

Additional Facts. The correct chemical name for the elastomeric materiel in question is Ethylene Propylene Diene Monomer (EPDM); not Ethylene Propylene Diene Terpolymer (EPDT).

Recommendation C-2. That the Army Project Manager, Nuclear Biological Chemical Defense Systems re-evaluate the use of Ethylene Propylene Diene Terpolymer material for its chemical and biological protective systems. If EPDT does not resist chemical permeation adequately, we recommend discontinuing use of this material.

Action Taken. Concur. The Edgewood Research, Development and Engineering Center will immediately form a team of subject matter experts to review the test and evaluation data for all items that have EPDT material as a component. The various items will be individually considered against their specific protective requirements. The team will prepare a final report with recommendations by 31 March 1993.

Management Comments: Acting Assistant Secretary of the Navy (Research, Development and Acquisition)

Final Report
Reference



DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(Research, Development and Acquisition)
WASHINGTON, D C 20350-1000

MAR 8 1993

MEMORANDUM FOR THE DEPARTMENT OF DEFENSE INSPECTOR GENERAL

Subj: AUDIT REPORT ON THE ACQUISITION OF AIRCREW CHEMICAL AND BIOLOGICAL PROTECTIVE SYSTEMS

Ref: (a) DOD IG memo of 11 Dec 92 (Project No. 2AL-5006)

Encl: (1) Department of the Navy comments

Enclosure (1) provides our reply to pertinent findings and recommendations of reference (a).


Edward C. Whitman

Management Comments: Acting Assistant Secretary of the Navy (Research,
Development and Acquisition)

Final Report
Reference

"DRAFT REPORT ON THE ACQUISITION OF CHEMICAL AND BIOLOGICAL
PROTECTIVE SYSTEMS (2AL-5006)"

DEPARTMENT OF THE NAVY COMMENTS

PART II - FINDINGS AND RECOMMENDATIONS:

FINDING B. NAVY'S PLANNED ACQUISITION STRATEGY:

The Navy's planned two-phased acquisition strategy for procurement of aircrew chemical and biological protective systems was questionable. The first phase was questionable because the Navy had not validated the urgency of the planned sole source procurement of 1,200 AR-5 hood/masks. The second phase was questionable because an option was included for the Navy to use the AR-5 technical development plan (TDP) for its planned competitive procurement of 6,510 chemical and biological protective systems. As a result, the Navy could spend as much as \$30 million unnecessarily for chemical and biological protective systems and could receive untimely deliveries or deliveries of unsatisfactory protective systems or both.

Navy Comments:

Partially concur. The Navy's acquisition strategy is not accurately represented. The Navy's planned acquisition strategy, approved by the Navy's Decision Authority, was comprised of two phases:

Phase I - Procure 1200 Desert Storm Configurations as soon as possible, only if: a) the urgent need is confirmed in writing by OPNAV/Fleet and, b) the Desert Storm Configuration successfully passed TECHEVAL. Procure the blower, H manifold, communication cords, and intercom competitively. Procure the AR-5 Hood/Mask sole source. Include an option in the AR-5 contract to procure a manufacturing TDP.

Phase II - Procure remaining requirement of 6,510 Chemical Biological (CB) systems through a Non-Development Item (NDI) best value approach. (If the option to procure the TDP was exercised, based on a cost benefit analysis and funds availability, the remaining requirement could be procured by an open competition using the TDP.)

DOD INSPECTOR GENERAL: PAGE 16:

Intelligence assessment. Naval intelligence personnel could not validate an immediate threat. Naval Technical Intelligence Center Threat Assessment for Naval Chemical and Biological Warfare, dated March 1991, defines threat as "The sum of the potential strength, capabilities, and intentions of any enemy which can limit or negate mission accomplishment or reduce force, system or equipment effectiveness." The threat assessment noted that several countries in which the United States has a strategic interest possess a threat of chemical and biological

Management Comments: Acting Assistant Secretary of the Navy (Research, Development and Acquisition)

Final Report Reference

warfare. Although this has been evident for several years, Nav intelligence personnel could not validate an immediate threat because the intent of the enemy to use chemical and biological agents was indeterminable.

NAVY Comments:

Do not concur. The preface to the Naval Maritime Intelligence Center Threat Assessment for Naval Chemical and Biological Warfare, dated September 1992 states, "This threat assessment was prepared to support U.S. Navy Chemical and Biological Warfare (CBW) programs with intelligence concerning the current and projected threats.." Any potential adversary who currently possesses CBW agents may be construed as an immediate threat given certain conditions; (e.g., previous patterns of CBW employment, hostility level, perceived likelihood of use, and so on). Lessons learned from recent history of the Gulf War demonstrated how poor the chemical/biological readiness level was/is for U.S. forces. The CB threat was a concern during Desert Shield/Storm. Congressional level interest was evidenced by testimony before the Subcommittee On Readiness in April 91. The warfighting planner must consider the potential adversary's current capabilities and capacity for employment to decide if a given threat is "immediate". The Naval Technical Intelligence Center provides information of capabilities, existing strength and intentions of enemies and potential adversaries. Although Naval Intelligence personnel could not validate an immediate threat, it is beyond their charter to draw conclusions regarding Operational Requirements, or requirements for aircrew personal CB protection equipment.

DOD INSPECTOR GENERAL: PAGE 20:

RECOMMENDATIONS FOR CORRECTIVE ACTION (1):

We recommend that the Chief of Naval Operations adhere to the input from the Atlantic and Pacific Fleets and the Marine Corps and decide that procurement of aircrew chemical and biological protective systems is not urgent and does not justify the use of sole source procurement procedures.

NAVY Comments:

Partially concur. The inputs from the Marine Corps, and Atlantic and Pacific Fleets clearly state that each has a current requirement for the aircrew CB protection afforded by the AR-5 as "the only means of protection to aircrews in the event of a chemical attack." What the CINC's also say, however, is that they cannot afford to purchase the CB equipment, with Fleet O&M,N funds. It is, therefore, the affordability of the AR-5, vice the requirement which resolves this issue. The requirement has proven itself time and again and the CB threat continues to flourish. The Navy will discontinue its "urgent requirement" validation and focus our efforts on fielding a more affordable device which provides aircrew CB protection.

Management Comments: Acting Assistant Secretary of the Navy (Research,
Development and Acquisition)

Final Report
Reference

Recommendation B.2:

2. We recommend the Navy Program Manager, Aircrew Systems:

a. use full and open competition procedures for any procurements of aircrew chemical and biological protective systems.

Navy Comments:

Concur. Since Navy has not established an urgent need, 7,710 CB systems will be procured by competitive NDI best value, as planned and approved by our Acquisition Decision Authority. Preparation of a competitive NDI best value procurement package is in progress, and will be released to industry. The draft for the proposal is to be released in September 1993.

b. Perform cost-effectiveness and risk analyses to evaluate the cost and risk impact of using the British AR-5 Aircrew Respiratory System's Technical Data Package for competitive procurement as opposed to the Navy's performance specifications before deciding whether to use the British AR-5 Aircrew Respiratory System's Technical Data package for procurement purposes.

Navy Comments:

Concur. This recommendation was part of our approved acquisition strategy.

Recommendation D.1:

We recommend that the Navy Program Manager, Aircrew Systems;

1. Provide for an equitable comparison of the Protective Integrated Hood Mask to the British AR-5 Aircrew Respiratory system before the initiation of any procurement of the British AR-5 Aircrew Respiratory System.

Navy Comments:

Partially concur. Our current acquisition strategy is to procure Aircrew systems through a competitive NDI best value approach, which will include side-by-side testing. Identical test protocols will be used for all submitted candidate systems assuring an equitable comparison.

Recommendation D.2:

Provide for an equitable comparison of all aircrew chemical and biological protective systems offered to the Navy in response to a Request for Proposals.

**Management Comments: Acting Assistant Secretary of the Navy (Research,
Development and Acquisition)**

**Final Report
Reference**

Navy Comments:

Concur. Our acquisition strategy is to procure new CB systems through a competitive NDI best value approach, requiring all offerors to meet identical test requirements. NAVAIR will prepare a Request for Proposals (RFP) with the test requirements identified, which will be applicable to all offerors. Preparation of a statement of work for the RFP is in progress. The estimated completion date is September 1993.

Recommendation D.3

Provide for adequate operational test and evaluation of any chemical and biological protective system before any system production.

Navy Comments:

Concur. A suitable operational test and evaluation will be conducted before a production decision is made. The operational effectiveness and operational suitability will be verified by the Navy's independent operational test activity, COMOPTEVFOR. The estimated completion date of the operational testing is September 1995 .

Recommendation D.4:

Participate with the U.S. Army Chemical Process Action Team (CPAT) to establish standards for testing chemical and biological protective systems.

Navy Comments:

Concur. Joint Service Standardization is necessary to assure equitable comparisons. NAVAIR will initiate a request to the CPAT to include a representative from Naval aviation. The estimated completion date is April 1993.

Navy Specific Comments:

12 Page 14, Paragraph 2 - Background. Concur

12 Page 14, Paragraph 2 - Urgent Sole Source Procurement. Concur. Navy has not validated that there is an urgent need.

13 Page 15, Paragraph 3 - Justification of urgency. Concur.

Management Comments: Acting Assistant Secretary of the Navy (Research,
Development and Acquisition)

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Page 15, Paragraph 3 - Justification of urgency. Concur.

13

Page 16, Paragraph 4 - Other than full and open competition. Partially concur. If the Navy urgency of need was established, two exceptions under Federal Acquisition Regulations (FAR) would enable a sole source procurement:

13

- 1) Unusual or compelling urgency,
- 2) Only, one responsible source.

14

Page 17, Paragraph 2 - Follow-on Competitive Procurement. Do not concur. The primary approved acquisition strategy is to procure 6,510 hood/masks through open competition, NDI best value. The Navy has not solicited a proposal to procure the AR-5 TDP. The cost of the TDP, if made available, is unknown.

14

Page 17, Paragraph 3 - Competition. Partially concur. A secondary approach to procure competitively is by using a TDP with production drawings, if a package is available and cost effective. All available strategies to put the Navy in the best position would be employed contractually (i.e. application of appropriate sections of U.S. Navy Procurement Technical Data Handbook) to minimize Navy risk. The technical data package could be verified by an independent source and a qualified products list could be established. Production proofing via a second source can also be accomplished. A contractual requirement to establish a second source by the offerer/current approved source could be considered. Procuring via a "build to print" TDP is also an established method of procurement encouraged by DOD policy. The Air Force used this method to procure the PIHM. There are many advantages to procuring one system design: logistic support-interchangeability of parts, one complement of spare and repair parts, one maintenance manual, one maintenance plan, one support equipment manual, improved safety (aircrews only have to be familiar with one system), reduced engineering support costs basic design engineering support for one configuration, maintain one set of drawings, Correct deficiencies for one system.

If a technical data package is available to competitively procure a CB system, or any system, the onus is on the private sector contractors to weigh the cost/benefits to determine if it is a good business decision to enter into the competition. A British firm might not have a cost advantage because of such factors as dollar/pound rates, cost of material, etc. There is also the possibility of the British firm setting up their U.S. sister company (AIRLOCK, Inc., Connecticut) as a producer.

Page 18 Paragraph 2 - Cost of TDP. DO not concur. We don't know the cost of the TDP. The \$6 million dollar cost for the TDP is based on a 1987 cost proposal, which was deemed unaffordable at that time and is no longer valid. There have been obstructions in the past in obtaining a TDP for the AR-5. They are: 1) release by the United Kingdom Ministry of Defense (UKMOD) and 2) funds availability. There are currently no plans to solicit a cost proposal for the TDP.

15

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15

Page 18, Paragraph 3 - Cost of systems. Do not concur. The cost estimate of \$30 million is not valid and can not be used for comparative purposes. The projection is based on a \$24 million AR-5 production cost and \$6 million for the AR-5 TDP. The unit cost comparison between the Air Force and Navy systems is based on significantly different quantities, hardware items, and does not include the Air Force cost of the PIHM TDP. The following table summarizes the invalid cost comparison:

ITEM	QUANTITY TO PURCHASE	DODIG UNIT COST	UNIT COST BASIS	TOTAL COST
AR-5	7,710	\$4,200	50 SYSTEMS	\$32,382,000 (1)
PIHM	7,710	\$1,050	10,500	\$ 8,095,500 (2)
DELTA	0	\$3,150	10,450 UNITS	\$24,286,500

Notes:

- (1) Includes \$6 Million for TDP
- (2) Does not include TDP costs

The AR-5 unit cost was based on a previous Navy purchase of 50 systems. The PIHM unit cost was based on a previous Air Force purchase of 10,500 masks. If the AR-5 production quantity was increased from 50 systems to 10,500, the unit cost would decrease significantly!

The \$4,200 AR-5 system unit cost includes the intercom unit (\$199), Navy Blower (\$130), the blower battery (\$100), and the communication cords (\$250).

The \$1,050 PIHM mask unit cost does not include the rest of the system components. It should include the intercom unit (\$199), the blower (\$960), blower batteries (\$60) and the communication cords (\$250), and the individual aircraft modification costs. A minimum PIHM system cost of \$2,519 should be used. Also, the cost of the Air Force TDP is not included in the Air Force system cost. Numerous and significant PIHM hood and system deficiencies are described in this report and these may require costly modification. There is reason to expect a significant cost increase, both in hardware and in development testing. The cost of a new PIHM TDP could also be substantial, since the Air Force acquired the original TDP at substantial cost.

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The \$6 Million dollar cost for a TDP was proposed by the previous UKMOD approved source for the AR-5 system, and was not negotiated or determined to be acceptable to the Navy. March 1992 discussions with the UKMOD representatives suggested the TDP might be provided at no cost or very little cost.

The cost comparison does not compare life cycle costs for the two systems. The AIR Force system includes a requirement to modify each aircraft to accept a blower to be CB compatible. The Navy AR-5 system does not require any aircraft modification. Integration of the PIHM into Navy aircraft would require expensive non-recurring cockpit modification costs to incorporate the blower.

Life cycle costs determine tangible savings/expenses which should also be compared. Examples are development and testing costs, logistic support documentation costs, support equipment costs, spare and repair parts provisioning costs, service life, and refurbishment costs (if appropriate). In addition, costs associated with supporting at least two systems for the following items should consider: interchangeability of parts, spare and repair parts, maintenance manuals, maintenance plans, logistics support plans, training plans, operational training manuals, training devices, support equipment, and support equipment manuals.

Page 19, Paragraph 2 - Conclusion. Do not concur. Even with a thorough analysis, it cannot be determined that use of the Navy's performance specifications will be the most cost effective and risk free method to procure CB systems.

Finding D:

The Navy's determination that the AR-5 represented a superior chemical biological protection system in comparison to the PIHM may not be valid. This condition resulted from the Navy's using methods to evaluate the AR-5 hood/mask that were different from those used to evaluate the PIHM hood/mask. Also, the Navy immediately rejected the PIHM, when deficiencies were identified but modified the AR-5 as deficiencies were identified. In addition, the Navy did not plan to conduct operational test and evaluation of the AR-5. As a result, the Navy may have foregone benefits available on the PIHM, which may be an equally effective, less costly protective system.

Page 32, Paragraph 2 - Background. Concur. Clarification is needed. The chronology of events for the Navy CB program is important to objectively evaluate the testing which was conducted. 3,190 USMC CB systems were procured sole source in 1986/1987 in response to a requirement identified by CMC to equip a rapid deployment force.

A joint Aircrew CB program was initiated with the USAF in 1987 to address all Navy/USMC aircraft applications. The joint program with the Air force was the only development program the Navy had ongoing until Operation Desert Shield.

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The advent of Desert Shield forced both services to accelerate prog. actions to provide deployed forces with CB protection. The USN initiated procurement of the development system and accelerated airframe mods. The USN CB team identified, engineered, tested, trained, and deployed a functional CB system for tactical USMC/USN aircrews (development system was not a viable option for the USN because of limited hardware availability and poor performance). The USN system was based on the Canadian F/A-18 CB configuration: AR-5 hood/mask, oxygen system plumbing, man mounted blower/filter system (no aircraft mods required), intercom. The Canadian Armed Forces loaned the USN 250 AR-5s enabling us to provide limited protection to tactical aircrews prior to Desert Storm. The USAF did not field a new system prior to the end of Desert Storm.

Testing/engineering of the USN AR-5 Desert Storm system continued during and after the conflict. Navy testing of the joint system also continued with TECHEVAL of the PIHM in the P-3C aircraft; 7 Part I, 13 Part II, and 2 part III deficiencies were identified. The joint system had previously failed to meet development test chemical agent permeation test requirements.

Testing should not be discounted because it was not done side by side. Test results should be judged against pre-test established requirements and system acceptability in its intended application. A program was never structured to compare the two systems, side by side. The only concurrent comparisons between the two systems were for chemical permeation because of poor PIHM test results.

26 Page 33, Paragraph 1 - Evaluation Methods. Do not concur. Although not concurrent, the same technical test criteria was used to evaluate the PIHM and AR-5 systems. Pre-flight, aircrew familiarization, physiological monitoring, donning/doffing, and numerous other elements were common to both the AR-5 and PIHM system evaluations. Fleet requirements, aircraft type and availability, test resources and goals, and safety considerations may cause variations in protocols. However, this does not introduce a test bias.

26 Page 33, Paragraph 2 - Aircraft types. Do not concur. The AV-8 and the F/A-18 platforms were not chosen by the Navy to provide a more favorable evaluation of the AR-5 system. The Navy PIHM/P-3 and the Navy AR-5/AV-8/F/A-18/OV-10 evaluations were not conducted or analyzed to directly compare the PIHM and AR-5 systems. Each system was required to perform satisfactorily in each aircraft type. The PIHM evaluation was conducted as part of a Navy TECHEVAL from the joint program, while the AR-5 evaluation was high priority and conducted for Desert Shield to develop and test equipment for anticipated near-term combat environment. Operation Desert Shield required the rapid evolution of a Navy fixed wing aircraft hood/mask. This resulted in AR-5 system variants manufactured in-house by the Navy from Canadian forces AR-5 hood/mask system assets. This program indicated that the improved AR-5 system variants were viable candidates for Navy fixed wing aircraft applications.

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The effects of heat stress for aircrew wearing any CB protective system is known to be debilitating and has been well documented by the Navy and other services. During the Navy AV-8, F/A-18, and AR-5 evaluations, aircrew were instructed to use "buddy" aircraft pre-flight to reduce heat stress. As part of the Navy P-3/AR-5 system evaluation, the aircrew ordnance man was outfitted with the AR-5 system and protective clothing ensemble and directed to perform heavy duty sonobuoy loading. The heat stress issue was not neglected by the Navy when evaluating the AR-5.

27

Page 4 Paragraph 2.3.4 - Physiological recorder/Pre-flight duties/Familiarization exercises. Do not concur. The audit appears to address testing conducted during TECHEVAL only. Physiological data has been collected for both the PIHM and AR-5 system in detail during developmental flight and lab tests. Pre-flight duties were conducted with both the PIHM and AR-5 systems. Familiarization of the PIHM system for test subjects was identified in the test plan.

27

Page 34. Paragraph 5 - Donning and doffing. Partially concur. PIHM donning and doffing procedures were considered a problem in TECHEVAL and reported as a Part II deficiency. Donning the AR-5 was also reported as potential problem in the helicopter heat stress evaluation.

28

Page 35. Paragraph 2 - Correction of Deficiencies. Do not concur. Extensive -E- system design integration changes were accomplished to improve performance and enhance aircraft and aircrew flight equipment integration.

Problems with the PIHM such as breathing resistance, flow resistance, and agent protection were not correctable without major rework/replacement of the hood/mask. The PIHM system failed Navy Laboratory tests, not related to any specific aircraft, and failed P-3 TECHEVAL flight trials.

The following major system hardware and integration efforts were initially implemented by the Navy and were intended solely to improve the PIHM system:

- a. Breathing/Ventilation:
 - T-Manifold
 - H-Manifold
 - J-Manifold
 - Hunter blower
 - Racal Blower
- b. Oxygen systems;
 - Liquid Oxygen regulator
 - OBOGS Regulator
 - Panel Regulator
- c. Personal Equipment and maintenance:
 - Communication cords
 - Survival Vest

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Spectacles
Portable Test Set

- d. Aircraft Integration:
P-3 Installation Kit
Improved Aircraft Installation Kit

28 Page 35, Paragraph 3 - H-manifolds. Do not concur. The H-manifolds were initially conceived and designed to be used with the PIHM hood/mask. Testing revealed major problems with the Boeing/ILC/USAF PIHM manifold (misting, confusing multiple hook-ups and disconnects). Laboratory tests revealed that even with the new USN manifolds, the performance of the PIHM was unsatisfactory. The H-manifolds were subsequently incorporated into the AR-5 system and superior and satisfactory test results were achieved.

28 Page 35, Paragraph 4 - Spectacles. Partially concur. One of the requirements of the CB system was to be compatible with the standard aircrew spectacles. The Navy reported in the P-3/PIHM TECHEVAL an interface problem existed and recommended the use of the British design AR-5 spectacles as a corrective action.

28 Page 35, Paragraph 5 - Navy helmet interface. Partially concur. The Navy provided off the shelf helmet fittings to be used in conjunction with the AR-5. Few fittings were not developed. This is a low cost integration issue, not a design deficiency.

28 Page 36, Paragraph 1 - Drinking tube. Concur. The USN redesigned the drinking system and used only a portion of the existing PIHM assembly. The new system is a low cost improvement which is incorporated without difficulty. The new facility would be incorporated into the PIHM if it were still a viable candidate.

29 Page 36, Paragraph 2 - Operational Test and Evaluation. Do not concur. Development Testing of the modified AR-5 systems was conducted by NAWC Warminster. TECHEVAL testing was initiated at NAWC Patuxent River to evaluate the F/A-18 and AV-8 operational effectiveness and suitability. A formal "OPEVAL" by COMOPTEVFOR was deemed not necessary by COMOPTEVFOR, the Navy's independent operational test and evaluation activity, who have been involved with monitoring the development testing of the systems. OPTEVFOR was/is planning to conduct an operational assessment of the modified system. An OPEVAL was conducted on the USMC CB system in FY-86 and FY-87.

29 Page 37 Paragraph 2 - Chemical Permeation. Partially concur. The Navy agent test data show the AR-5 materials provide a significantly greater degree of protection from chemical agent penetration. Identical test protocols were used to test the PIHM and AR-5. Identical test protocols were also used to determine Quantitative Fit Factor (QFF), which is a measurement of leakage and represents the ratio of simulant outside the system to the simulant inside the system. The data show the AR-5 system provides approximately 3 times the

Management Comments: Acting Assistant Secretary of the Navy (Research,
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Protection capability from vapors and aerosols as the PIHM systems.

There was an absolute and measurable difference in performance of the systems regarding CB protection capability. The Chemical Process Action Team (CPAT) deliberations may result in different and improved test protocols; however, CPAT cannot impact inherent performance characteristics of systems.

30

Page 37, Paragraph 3 - Conclusion. Do not concur. The Navy conducted impartial testing of CB systems to determine suitability in Navy aircraft applications. Foremost, the PIHM failed to meet the established, primary requirements of a CB system: chemical permeation. There would be no advantage (actually more harmful) to make aircrew wear a cumbersome, heat stressful system if the system could not protect them from the potential CB threat. Extensive deficiency corrective design work and integration efforts were attempted and accomplished by the USN; however, the -H- proved to be an unacceptable system.

30

Page 38, Paragraph 2 - Discussions with Management. Concur.

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)



OFFICE OF THE ASSISTANT SECRETARY

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

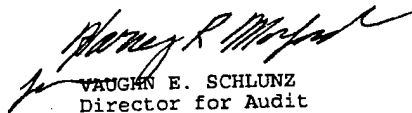


MEMORANDUM FOR ASSISTANT INSPECTOR GENERAL FOR AUDIT
OFFICE OF THE INSPECTOR GENERAL
DEPARTMENT OF DEFENSE

SUBJECT: Draft Audit Report On the Acquisition of Aircrew
Chemical and Biological Protective Systems (Project 2AL-
5006) -- INFORMATION MEMORANDUM

The attached memorandum from SAF/AQ is in reply to your request for Air Force comments.

The SAF/FMPF point of contact is Harvey R. Morford, ext. 7-6051.


VAUGHN E. SCHLUNZ
Director for Audit
Liaison and Followup
(Financial Management)

Atch
Air Force comments Feb. 10, 1993

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)



DEPARTMENT OF THE AIR FORCE
WASHINGTON DC



OFFICE OF THE ASSISTANT SECRETARY

February 10, 1993

MEMORANDUM FOR SAF/FMPF

SUBJECT: Draft Audit Report on the Acquisition of Aircrew Chemical and Biological Protective Systems, Office of the Inspector General, Department of Defense, Project No. 2AL-5006, December 11, 1992 - INFORMATION MEMORANDUM

We have reviewed the Draft Audit Report and offer the following comments and status reports for your consideration

a. Recommendation A.1 (1) Concur except for the phrase "...that blowers and communications sets are required at a ratio of one per aircrew seat..." Required sets should be based on a one for one ratio for aircrews who may fly in a contaminated environment. Rationale: Varied aircrew taskings and the difficulty of controlling equipment in a toxic environment make it likely that combat sorties would be delayed or cancelled by the nonavailability of needed equipment if issued on a one per seat basis.

(2) Proposed Action: The Air Force has reduced the number of required aircrew protective systems from 41,056 to 37,189 by deleting the requirement to provide a PIHM for personnel in staff positions who would not fly in a contaminated environment and by taking into consideration planned force reductions.

(3) Completion date: The above action was completed by HQ ACC/DOS, Langley AFB, VA, message, 301957Z Nov 92, to HSC/YA, Kelly AFB, TX.

(4) Monetary Benefits: The reduction in required systems provides an immediate cost reduction of \$8,542,203 (3,867 systems multiplied by the system cost).

(5) Internal Controls: Requirements will be reviewed each time a force adjustment is made and procurement adjusted accordingly.

b. Finding A.2. Concur.

(1) Proposed action: Written procedures have been published to conduct requirement reviews quarterly or upon change of force structure.

(2) Completion Date: February 1, 1993.

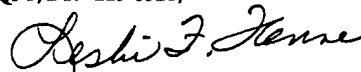
(3) Monetary Benefits: To be realized in any future adjustments to force structure.

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)

(4) Internal Controls: Written instructions have been issued to require HQ ACC/DRWC Chemical/Biological Program Manager to review equipment requirements quarterly or upon any change in force structure.

b. Recommendation C.1. Concur. A report of the implementation status of the Air Force Action Plan is at Attachment 1.

My point of contact is Capt John Olavarria, SAF/AQPT, DSN 225-0328;
Telefax DSN 223-6706.



LESLIE F. KENNE, Colonel, USAF
Deputy Director
Fighter, C2 & Weapons Programs
Assistant Secretary (Acquisition)

1 Atch
HSC Action Plan Status

cc: SAF/AQXA

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS HUMAN SYSTEMS CENTER (AFMC)
2701 WEST ROAD
BROOKS AIR FORCE BASE TEXAS 78235-5283

26 JAN 1993

REPLY TO
ATTN OF YA

SUBJECT Aircrew Eye/Respiratory Protection Status and Action Plan Update

TO SAF/AQP

- 1 Reference (A) 30 Oct 92, HSC/YA letter, subject Aircrew Eye/Respiratory Protection Status and Action Plan
(B) 11 Dec 92, Draft Audit Report on the Acquisition of Aircrew Chemical and Biological Protective Systems (Project No 2AL-5006)

2 In response to the DoD IG audit of the Aircrew Eye/Respiratory Protection (AERP) and our own internal review of the development program, the Human Systems Program Office has been implementing the actions described in Reference A. The program office concurs with "Finding C" in Reference B. As requested, this letter also provides an updated status of the corrective action plan previously provided (Reference A). Observation of the planned testing and review of results by your office or the IG are welcome.

3 Chemical Vapor Permeation of the Hose Assembly As reported in our earlier memo, the oxygen delivery hose of the AERP was subjected to a full hose testing and exhibited the breakthrough value of 1/17 the failure criterion. As a result, the current hose meets all chemical agent permeation requirements. The program office believes that this test method provides more representative and accurate performance characteristics of the hose in the operational mission environment. We are currently formalizing the test procedures to be submitted to the Chemical Defense Equipment Process Action Team (CDE-PAT) as the recommended method for all hose testing. It will be submitted at the next CDE-PAT meeting.

4 Chemical Vapor Permeation of the Valsalva Pads The program office is currently conducting a System Chemical Assurance Test on a full AERP system in a chemical agent environment. The test challenges the AERP from the demist hose/oxygen delivery hose up. The objective of this test is not only to measure the rate of the chemical permeation through the system but also the chemical concentration at three physiologically critical regions of the head: eye, mouth, and the nose. The test simulates the realism of the operational environment by 1) providing stable chemical challenge to the AERP system throughout the required mission time; and 2) simulating the wearer of the AERP system using the breathing machine and the electric blower. The test results are expected to be available by February. Concurrent with the test effort, the program office is exploring new design alternatives to improve the chemical resistance of the current valsalva pad. Any changes made to the valsalva region will be coordinated with the user community to ensure the valsalva maneuver can still be performed with the modified system.

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)

5 Lens Fogging As indicated in our previous response (Reference A), the two potential causes of lens fogging are 1) improper fitting of the mask; and 2) possible blockage of the demist hose due to the kinking of the hose. The program office conducted tests to verify the defogging phenomena with the AERP system. The results from the testing indicated that when the masks are fitted properly the fogging will be minimized and will not cause any vision impairment (please refer to our previous letter for the data). The program office has incorporated an Engineering Change Proposal (ECP) which strengthens the demist hose to prevent kinking; thereby, eliminating lens fogging. The ECP has been incorporated into test units, and has successfully passed required testing (i.e., Windblast, Ejection Tower, etc.). The modification will be incorporated into all future production buys of the AERP system, and currently stocked items will be retrofitted.

6 Physiological Factors We have asked the user to revalidate the mission duration requirement -- currently 16 hours. Our user indicated that the requirement is 12 hours, with a goal of 16 hours. We are in the process of finalizing the procedures and protocol, with Armstrong Laboratory, to conduct a 12 hour wear test. We currently plan to conduct this test in early February 1993. The wear test (heat stress and breathing resistance) will be conducted to evaluate the ability to perform the required mission when the AERP system is worn.

7 Valsalva maneuver As mentioned in our previous letter, the Air Force will conduct additional training to ensure that subjects can perform a one-handed Valsalva maneuver to meet their operational requirement while wearing chemical defense gloves. The Valsalva Pad Redesign effort, as mentioned above, places emphasis on improving the aircrew's ability to perform the one-handed Valsalva maneuver.

8 Other tests

a Armor Quick Disconnect (AQD): An ECP to improve the AQD, so it will not inadvertently disconnect from the filter, has been incorporated into test units. The program office has successfully reaccomplished all required testing (e.g., Windblast, Ejection Tower, etc.), ensuring the change did not adversely affect the system performance. The change will be incorporated into all future production buys, and all currently stocked items will be retrofitted.

b Water Drag Tests. The program office is developing a Passive Anti - Drown Device (PADD) due to the difficulties experienced during water drag tests. The technical challenge regarding the electromagnetic interference during ejection sequence has been resolved; and, we are on schedule to incorporate PADD into the AERP system.

9. In summary, the corrective actions outlined in our previous letter (Reference A) to the DoD IG are all well underway. We already have accomplished the tasks regarding the Passive Anti - Drown Device, Armor Quick Disconnect, Oxygen delivery hose, and the Demist hose. The program office is currently conducting the System Chemical Assurance Test and will conduct the

Management Comments: Air Force, Deputy Director, Fighter, C2 and Weapons Programs, Assistant Secretary (Acquisition)

physiological tests in early February. We will integrate changes to materials, design or functionality, as necessary following the planned testing. All modifications of the AERP system will be integrated concurrently and timed appropriately to match with planned procurement and sustainment activities at HSC/YAD, Kelly AFB, TX. Current integration is targeted sometime between Mar - Aug 93. I remain committed to delivering a quality product to the users.

Mahlon H Long III

MAHLON H LONG III, Colonel, USAF
Program Director
Human Systems Program Office

cc: HSC/CC
ACC/DRWC

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